



SCHOOL of  
GRADUATE STUDIES

EAST TENNESSEE STATE UNIVERSITY

East Tennessee State University  
**Digital Commons @ East  
Tennessee State University**

---

Electronic Theses and Dissertations

Student Works

---

December 1995

# Interactive Television in the Classroom: A Comparison of Student Math Achievement Among Three Instructional Settings

Sherri L. Hodge-hardin  
*East Tennessee State University*

Follow this and additional works at: <https://dc.etsu.edu/etd>

 Part of the [Curriculum and Instruction Commons](#), [Instructional Media Design Commons](#), and  
the [Science and Mathematics Education Commons](#)

---

## Recommended Citation

Hodge-hardin, Sherri L., "Interactive Television in the Classroom: A Comparison of Student Math Achievement Among Three Instructional Settings" (1995). *Electronic Theses and Dissertations*. Paper 2921. <https://dc.etsu.edu/etd/2921>

This Dissertation - Open Access is brought to you for free and open access by the Student Works at Digital Commons @ East Tennessee State University. It has been accepted for inclusion in Electronic Theses and Dissertations by an authorized administrator of Digital Commons @ East Tennessee State University. For more information, please contact [digilib@etsu.edu](mailto:digilib@etsu.edu).

## **INFORMATION TO USERS**

**This manuscript has been reproduced from the microfilm master. UMI films the text directly from the original or copy submitted. Thus, some thesis and dissertation copies are in typewriter face, while others may be from any type of computer printer.**

**The quality of this reproduction is dependent upon the quality of the copy submitted. Broken or indistinct print, colored or poor quality illustrations and photographs, print bleedthrough, substandard margins, and improper alignment can adversely affect reproduction.**

**In the unlikely event that the author did not send UMI a complete manuscript and there are missing pages, these will be noted. Also, if unauthorized copyright material had to be removed, a note will indicate the deletion.**

**Oversize materials (e.g., maps, drawings, charts) are reproduced by sectioning the original, beginning at the upper left-hand corner and continuing from left to right in equal sections with small overlaps. Each original is also photographed in one exposure and is included in reduced form at the back of the book.**

**Photographs included in the original manuscript have been reproduced xerographically in this copy. Higher quality 6" x 9" black and white photographic prints are available for any photographs or illustrations appearing in this copy for an additional charge. Contact UMI directly to order.**

# **UMI**

**A Bell & Howell Information Company  
300 North Zeeb Road, Ann Arbor, MI 48106-1346 USA  
313/761-4700 800/521-0600**



INTERACTIVE TELEVISION IN THE CLASSROOM:  
A COMPARISON OF STUDENT MATH ACHIEVEMENT  
AMONG THREE INSTRUCTIONAL SETTINGS

---

A Dissertation  
Presented to  
the Faculty of the Department of Educational Leadership  
and Policy Analysis  
East Tennessee State University

---

In Partial Fulfillment of  
of the Requirements for the Degree  
Doctor of Education

---

by  
Sherri Lynn Hodge-Hardin  
December 1995

**UMI Number: 9608988**

---

**UMI Microform 9608988**

**Copyright 1996, by UMI Company. All rights reserved.**

**This microform edition is protected against unauthorized  
copying under Title 17, United States Code.**

---

**UMI**


**300, North Zeeb Road  
Ann Arbor, MI 48103**

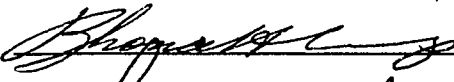
APPROVAL


This is to certify that the Graduate Committee of  
SHERRI L. HODGE-HARDIN  
met on the  
23rd day of October, 1995.

The committee read and examined her dissertation,  
supervised her defense of it in an oral examination, and  
decided to recommend that her study be submitted to the  
Graduate Council, in partial fulfillment of the requirements  
for the degree of Doctor of Education.

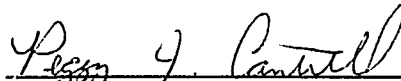
  
\_\_\_\_\_  
Chair, Graduate Committee

  
\_\_\_\_\_

  
\_\_\_\_\_

  
\_\_\_\_\_

Signed on behalf of  
the Graduate Council

  
\_\_\_\_\_  
Interim Dean,  
School of Graduate Studies

## ABSTRACT

### INTERACTIVE TELEVISION IN THE CLASSROOM: A COMPARISON OF STUDENT MATH ACHIEVEMENT AMONG THREE INSTRUCTIONAL SETTINGS

by

Sherri Lynn Hodge-Hardin

A dramatic expansion of distance learning through the use of interactive television (ITV) is allowing colleges and universities to offer students potentially unlimited access to educational and training opportunities. While the expanding information age beckons us to consider mechanisms for using communication technologies for the benefit of meeting the needs of learners in a variety of locations, the question may be raised --- Is ITV an effective medium of instruction? This study examined the effectiveness of using an interactive television system to broadcast developmental algebra classes at East Tennessee State University.

The purpose of this study was to determine if there were differences in math achievement of students taught in an ITV class setting with the instructor present (host site), students receiving instruction via television at an off-campus location (remote site), and students taught in a traditional classroom setting. This study also examined student attitudes toward enrolling in future ITV courses.

Results showed no significant differences in math achievement among the three groups. There were also no differences in student attitudes toward enrolling in future ITV courses when comparing the host site with the remote site. Students in both television settings had positive attitudes toward future ITV course participation.

The results of this study show that in developmental algebra students at the distance learning sites are learning as well as those students in the traditional classrooms. Thus, it was concluded that interactive television should be considered as an adequate method of providing developmental algebra instruction beyond the campus.

INSTITUTIONAL REVIEW BOARD APPROVAL

This is to certify that the following study has been  
filed and approved by the Institutional Review Board of East  
Tennessee State University.

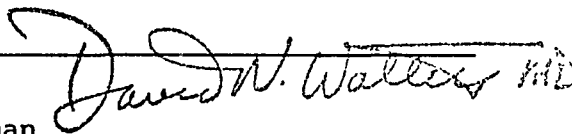
Title of Grant or Project Interactive Television in the  
Classroom: A Comparison of Student Math Achievement Among  
Three Instructional Settings

Principal Investigator Sherri Lynn Hodge-Hardin

Department Educational Leadership and Policy Analysis

Date Submitted June 5, 1995

Institutional Review Board, Chairman

  
David W. Waller



## CONTENTS

	Page
APPROVAL . . . . .	ii
ABSTRACT . . . . .	iii
INSTITUTIONAL REVIEW BOARD . . . . .	iv
LIST OF TABLES . . . . .	viii
Chapter	
1. Introduction . . . . .	1
Distance Learning at ETSU . . . . .	5
Statement of the Problem . . . . .	6
Purpose of the Study . . . . .	6
Hypotheses . . . . .	8
Significance of the Problem . . . . .	9
Limitations . . . . .	10
Definition of Terms . . . . .	10
Overview of the Study . . . . .	13
2. Review of Related Literature . . . . .	14
Introduction . . . . .	14
Historical Overview of Distance Education . . . . .	14
Evolution of ITV . . . . .	19
Positive Findings . . . . .	27
Negative Findings . . . . .	35
Instructor Effectiveness . . . . .	41
Distance Students . . . . .	50
Summary . . . . .	54

Chapter	Page
3. Methodology . . . . .	55
Research Design . . . . .	55
Variables in the Study . . . . .	55
Population . . . . .	56
Sample . . . . .	57
Instrumentation . . . . .	61
Data Collection . . . . .	64
Control for Extraneous Variables . . . . .	65
Data Analysis . . . . .	65
4. Results of Data Analysis . . . . .	67
Null Hypotheses 1 and 2 . . . . .	68
Null Hypotheses 3 and 4 . . . . .	72
Null Hypotheses 5 and 6 . . . . .	75
Null Hypotheses 7 and 8 . . . . .	79
5. Summary, Conclusions, and Recommendations for Further Study . . . . .	82
Summary . . . . .	82
Conclusions . . . . .	87
Null Hypotheses 1 and 2 . . . . .	87
Null Hypotheses 3 and 4 . . . . .	88
Null Hypotheses 5 and 6 . . . . .	89
Null Hypotheses 7 and 8 . . . . .	91
Recommendations for Further Study . . . . .	93
REFERENCES . . . . .	95
APPENDIX A . . . . .	105

	Page
APPENDIX B . . . . .	112
VITA . . . . .	127

# LIST OF TABLES

Table	Page
1. Introductory Algebra Enrollment by Method of Instructional Delivery . . . . .	58
2. Intermediate Algebra Enrollment by Method of Instructional Delivery . . . . .	59
3. Introductory Algebra Enrollment by Student Age and Method of Instructional Delivery . . . . .	59
4. Intermediate Algebra Enrollment by Student Age and Method of Instructional Delivery . . . . .	59
5. Analysis of Covariance on Final Course Grade by Group and Age for Introductory Algebra . . . . .	69
6. Observed Group Means on Final Course Grade for Introductory Algebra . . . . .	71
7. Adjusted Group Means on Final Course Grade for Introductory Algebra . . . . .	71
8. Introductory Algebra Student Responses Toward Taking Another ITV Class . . . . .	73
9. Introductory Algebra Student Responses Toward Taking Another ITV Math Class . . . . .	74
10. Analysis of Covariance on Final Course Grade by Group and Age for Intermediate Algebra . . . . .	76
11. Observed Group Means on Final Course Grade for Intermediate Algebra . . . . .	78
12. Adjusted Group Means on Final Course Grade for Intermediate Algebra . . . . .	78
13. Intermediate Algebra Student Responses Toward Taking Another ITV Class . . . . .	80
14. Intermediate Algebra Student Responses Toward Taking Another ITV Math Class . . . . .	81

## CHAPTER 1

### Introduction

Traditional educational institution boundaries are being redefined as technology comes of age. A dramatic expansion of distance learning through the use of interactive television is allowing colleges and universities to offer students potentially unlimited access to educational and training opportunities. The idea that distance learning may soon become a major alternative to traditional campus programs has captured the attention of many people and organizations, from individual instructors and campus administrators to faculty unions, statewide coordinating boards, and regional accrediting agencies. In state after state, political leaders are providing funds to develop and augment distance learning networks (Jacobson, 1994).

The U.S. Congress Office of Technology Assessment defines distance learning as the "linking of a teacher and students in several geographic locations via technology that allows for interaction" (1989, p. 4). Distance education occurs when there is a "physical separation of the teacher and learner and when communication and instruction take place through, or are supported by, technological means such as telephone, radio, television, computers, satellite

delivery, interactive video, or any combination of present and future telecommunication technologies" (Tennessee Board of Regents, 1993, p. 1).

Descriptions of distance education tend to change radically, depending on which technology is being employed. Distance education today ranges from home correspondence courses to live, interactive television instruction (Sukow, 1992). Live, interactive televised instruction includes provision for students and faculty to interact with one another in real time (e.g., satellite, point-to-point microwave, cable T.V., etc.). Students also have immediate talk-back capability with the instructor (Commission on Colleges, 1993).

This type of distance education expands classrooms beyond the physical constraints of lecture halls and college campuses. Distance education gives students greater flexibility in scheduling and in locations of classes. Students who may have had difficulties attending classes at centralized, on-campus locations are now able to participate in those classes at locations removed from the centralized one (Britton, 1992). One of the prime advantages of an interactive television system is making university courses available to students who would not otherwise be able to pursue studies at this level. Many students work, have families, and are place-bound. Students find it a definite

advantage to have classes in their home community (Fulmer, Hazzard, Jones, & Keene, 1992).

Distance education is appropriate in a large geographical area with a sparse population and students who otherwise cannot be served. It is also appropriate in large metropolitan areas where traffic, parking, and other logistical constraints suggest that several learning sites may be simultaneously served by the same instructor (Magiera, 1994). Teaching students in multiple locations allows for small classes at a variety of sites to be combined to make a cost effective class. Rather than spending time in transit, faculty have more time for the essentials like teaching, scholarly activity, and service (Fulmer et al., 1992).

Teaching via interactive television (ITV) requires an instructor who is willing to learn to use technology to enhance his or her teaching style. In the case of teaching classes using one-way video with two-way audio, the instructor is seen by the students and can interact with them through the use of a telephone, but cannot see them in the usual sense. This lack of visualization can cause some difficulties that are not found in the traditional classroom (Britton, 1992). Britton has addressed skills necessary for instructors using ITV as a method of instructional delivery. Instructor behaviors which contribute to effective teaching are generally visual ones such as eye contact, gestures, and

facial expressions. When teaching via ITV alternative actions must be developed to enhance the overall teaching/learning transaction. Instructors should use a natural style of delivery by speaking slowly and enunciating clearly, maintain spontaneity and avoid reading from a script, use frequent change of pace or stimuli to maintain interest, make frequent attempts to involve students in discussions, try to refer to students by name, and give short concluding summary statements of concepts presented. Generally, those who do the best with ITV are instructors who are risk takers and are able to adjust their teaching styles to interact with students who remain anonymous (Graham, 1991).

People are the key to success in distance learning. These include motivated students, flexible on-campus faculty, and knowledgeable telecommunications personnel. Interactive communication presents both potential and promise for meeting the needs of distance learning. Television instruction provides an exciting challenge to administrators, faculty, and students (Fulmer et al., 1992).

While the expanding information age beckons us to consider mechanisms for using communication technologies for the benefit of meeting the needs of learners in a variety of locations, the question may be raised -- Is ITV an effective medium of instruction? A review of the literature showed that there are conflicting opinions about the usefulness and



effectiveness of interactive television in the classroom. None of the studies, however, focused on developmental algebra classes. This study examined the effectiveness of using an interactive television system to broadcast Introductory and Intermediate Algebra classes at East Tennessee State University (ETSU).

#### Distance Learning at ETSU

East Tennessee State University's Office of Instructional Television Services offers both live, interactive televised courses through ETSU's interactive television system and prerecorded telecourses through WSJK channel 2, ETSU's public television station. The live, interactive courses are regularly scheduled campus classes transmitted to off-campus locations through either a microwave or fiber-optic distribution system. Microwave instructional television fixed service (ITFS) courses, which support one-way video and two-way audio between the campus classroom and off-campus locations, are transmitted to the ETSU/UT Kingsport Center in Kingsport, Tennessee, the Bristol site in Bristol, Tennessee, and the Walters State Community College Center in Greeneville, Tennessee.

All ITFS class meetings are taped and copies are placed in the Instructional Media Center and the Kingsport University Center library for students to check out if they miss a class or wish to review a class session. The interactive television system allows the university to serve

undergraduate and graduate students at off-campus locations while also integrating them into the regular campus classroom. Classroom facilitators or faculty assistants meet with the students during class at all off-campus (remote) locations (ETSU Undergraduate Catalog, 1994-1995).

#### Statement of the Problem

Recent technological advances, as well as changes in demographics among student populations, have made television an increasingly viable medium for the delivery of university curriculum. As more university courses become available via interactive television systems in the future, research focusing on instructional practices in televised classrooms will have greater utility. This study was designed to investigate the effects of using interactive television (ITV) as a means of teaching developmental algebra at ETSU.

#### Purpose of the Study

This study examined three groups of Introductory Algebra students and three groups of Intermediate Algebra students. In both courses, one group was taught algebra in an interactive television setting. This group of students was given instruction in a television studio equipped with cameras. There were also microphones at each student desk. The instructor was physically present with these students. Math instruction was given on camera, with the students seeing the problems worked by the instructor on two overhead

television screens. Instruction originated in this on-campus studio (host site) and was transmitted to a group of students in Kingsport (remote site). These students in Kingsport comprised the second group in the study. They were part of this live, interactive instruction. They could talk to the instructor via cordless telephone at any time during the class. Students in Kingsport saw and heard everything as it happened in the on-campus studio. However, the students and the instructor at the on-campus site could only hear the students in Kingsport (two-way audio but only one-way video). The third group of students in the study was taught algebra in a traditional classroom setting. The teacher was present with these students and instruction was given utilizing the chalkboard.

This study focused on the achievement of these three groups of developmental algebra students. The purpose of the study was to determine if there were differences in math achievement of students taught in an ITV class setting with the instructor present (host site), students receiving instruction via television at an off-campus/remote location, and students taught in a traditional class setting. This study also compared traditional students and nontraditional students to see if there were differences in achievement based on age, as well as the instructional delivery method. Finally, this study tried to determine if students who enrolled in a developmental algebra course taught via

interactive television would consider taking another ITV course in the future, and if they would consider taking another ITV math course in the future.

### Hypotheses

The following null hypotheses were tested in this study:

H<sub>0</sub>1: There will be no significant differences in student achievement in Introductory Algebra using three different methods of delivering instruction: host site (ITV with the teacher present), ITV at remote site, and traditional classroom.

H<sub>0</sub>2: There will be no significant differences in student achievement in Introductory Algebra using three different methods of delivering instruction when comparing traditional students with nontraditional students.

H<sub>0</sub>3: There will be no significant differences in Introductory Algebra student attitudes toward enrolling in future ITV courses when comparing the host site with the remote site.

H<sub>0</sub>4: There will be no significant differences in Introductory Algebra student attitudes toward enrolling in future ITV math courses when comparing the host site with the remote site.

H<sub>0</sub>5: There will be no significant differences in student achievement in Intermediate Algebra using three

different methods of delivering instruction: host site (ITV with the teacher present), ITV at remote site, and traditional classroom.

H<sub>0</sub>6: There will be no significant differences in student achievement in Intermediate Algebra using three different methods of delivering instruction when comparing traditional students with nontraditional students.

H<sub>0</sub>7: There will be no significant differences in Intermediate Algebra student attitudes toward enrolling in future ITV courses when comparing the host site with the remote site.

H<sub>0</sub>8: There will be no significant differences in Intermediate Algebra student attitudes toward enrolling in future ITV math courses when comparing the host site with the remote site.

#### Significance of the Problem

Any new method of instructional delivery requires assessment to determine the strengths and weaknesses of the system. Technology applied to education produces a greater need to evaluate outcomes to provide evidence that students in ITV classrooms will achieve as well as those students taught in traditional classrooms. If the system fails to achieve these goals, the method of delivery needs to be reconsidered.

The use of interactive television to offer courses at remote locations holds promise for being an exciting method of reaching more students than would generally be able to attend if classes were restricted to lecture halls and classrooms on campus. If it can be shown that the students at the distance learning sites are learning as well as those students in the traditional classrooms, then there would be empirical evidence that ITV should be considered as an adequate method of providing instruction beyond the campus.

#### Limitations

This study was limited to students enrolled in developmental algebra classes at East Tennessee State University. Since this group of math students is unique, the results may not be generalizable beyond developmental mathematics classes. However, the results may have utility in other areas of distance learning through the use of interactive television.

This study was also limited to one instructor, who was also the researcher. This instructor, Sherri Hodge-Hardin, taught all three groups in the study in both the Introductory Algebra and Intermediate Algebra classes.

#### Definition of Terms

For the purposes of this study the following definitions will be used:

Distance Learning/Education: Formal instruction in which there is a "physical separation of the teacher and learner. Communication and instruction take place through, or are supported by, any technological means such as telephone, radio, television, computers, satellite delivery, interactive video, or any combination of present and future telecommunication technologies" (Tennessee Board of Regents, 1993, p. 1).

Host site/on-campus site: Site in a distance learning configuration where the instructor is physically located (Britton, 1992).

Remote site/off-campus site: Site in a distance learning configuration where the students are located and are linked to the host site by way of an electronic medium such as interactive television (Britton, 1992).

Interactive television (ITV): Television delivery where the host site is broadcast to the remote site. Students and instructor are able to interact with each other by way of two-way audio and one-way or two-way video connections (Simpson, Pugh, & Parchman, 1993).

Traditional classroom: A classroom that uses the traditional or conventional form of teaching with a teacher physically present in the classroom and directly providing instruction (Cartwright, 1994).

Traditional students: Students, age 22 and younger, enrolled in higher education courses (Center for Adult Programs & Services, ETSU, 1995).

Nontraditional students: Students, age 23 and older, enrolled in higher education courses (Center for Adult Programs & Services, ETSU, 1995).

Introductory Algebra: A developmental course emphasizing the fundamental operations of integers, polynomials, exponents, factoring, algebraic fractions, linear equations and applications, solving quadratic equations by factoring, and introduction to graphing (ETSU Undergraduate Catalog, 1994–1995).

Intermediate Algebra: A developmental course emphasizing sets, the real number system, fundamental operations, factoring, fractions, linear equations and inequalities, stated problems, exponents and radicals, relations, linear functions, graphs, quadratic equations, systems of equations and inequalities, ratios, and proportions (ETSU Undergraduate Catalog, 1994–1995).

Developmental Studies: The Division of Developmental Studies was created by East Tennessee State University to address the basic skills deficiencies common among a number of entering college students (ETSU Undergraduate Catalog, 1994–1995).



### Overview of the Study

Chapter one is an introduction to the study that includes: an overview of distance learning at ETSU, the problem statement, the purpose of the study, hypotheses, the significance of the study, limitations, and definitions of terms used in the study. Chapter two is a review of the literature related to the topic being investigated. Discussed in the literature review are the following: a historical overview of distance education, the evolution of ITV, positive findings, negative findings, instructor effectiveness, and distance students. Research design, variables used in the study, the population and sample, instrumentation, data collection, control for extraneous variables, and data analysis are the focus of chapter three. Chapter four is a presentation of the results of the data analysis. Chapter five includes a summary of the findings, conclusions, and recommendations for further study.

## CHAPTER 2

### Review of Related Literature

#### Introduction

The purpose of this review of related literature is to provide a foundation for distance education, specifically interactive television with two-way audio, as an instructional method. This study investigated the effects of ITV on student math achievement and on students' willingness to enroll in future classes being taught using ITV. If this mode of instruction is considered adequate and is to be taken seriously as a viable alternative to the traditional university classroom, then students at both the host and remote site must learn as well as students being taught in a traditional classroom.

This review of literature includes a historical overview of distance education, a discussion of the evolution of ITV, positive findings of successful uses of ITV, negative findings dealing with unsuccessful uses of ITV, instructor effectiveness in the interactive television setting, and a profile of the distance students who enroll in ITV classes.

#### Historical Overview of Distance Education

Distance education can be defined as "formal instruction in which a majority of the teaching function

occurs while educator and learner are at a distance from one another" (Verduin & Clark, 1991, p. 13). Formal distance education has been around since the early nineteenth century in the form of correspondence courses. Isaac Pitman is generally recognized to be the first modern distance educator. By profession a phonographer, he began teaching shorthand by correspondence in Bath, England, in 1840. This method of study appealed to adults who needed new methods of learning that would not conflict with their workdays. Students were instructed to copy brief Bible passages in shorthand and return them to Pitman for grading (Dinsdale, 1953).

In 1856, Charles Toussaint and Gustav Langenscheidt founded a modern language correspondence school in Berlin, Germany, which still publishes instructional materials under Langenscheidt's name. The Rustinches Fernlehrinstitut, which helped prepare students for university entrance examinations, was established in 1894 in the same city (Verduin & Clark, 1991).

Formal American distance study can be traced back to the Society to Encourage Study at Home. This organization was founded in 1873 by Anna Eliot Ticknor, the "mother of American correspondence study," who originated the exchange of comments as well as grades with students (Aggasiz, 1971).

In 1878, John Vincent created a home reading circle for adults. Vincent became one of the founders of the

Chautauqua movement, a popular education society based on the idea of expanding access to education to all Americans (Verduin & Clark, 1991). Moore (1989b) called Chautauqua "the first significant distance education effort in America" (p. 223). In 1882, the "father of American correspondence study," William Rainey Harper, induced Chautauqua educators to allow him to start a correspondence study program for his residential summer school students. After Chautauqua became an accredited university in New York, Harper headed the College of Liberal Arts, which came to emphasize distance study techniques. In 1892, he became the first president of the University of Chicago and founded the first university-level correspondence study division in America, largely using principles and ideas he had learned through his work at Chautauqua (Verduin & Clark, 1991).

One of the preeminent American distance teaching units, the University of Wisconsin-Extension, was founded in 1906. In 1919, University of Wisconsin professors started an amateur wireless station that three years later became WHA, the first federally licensed radio station devoted to educational broadcasting (Wedemeyer, 1983). Educational television broadcasting originated at the University of Iowa's W9XK between 1932 and 1937 (Koenig & Hill, 1967).

Distance learning involving one-way video and two-way audio technology has been used successfully to transmit courses from universities to remote sites in England for

several years. The Open University of the United Kingdom (OUUK) enrolls over 100,000 undergraduates a year and has a two-year waiting list. This university has been a model for distance education programs around the world (Britton, 1992). In England, "open learning" is the fastest growing area of education (Fulmer et al., 1992).

The meaning of distance education tends to change radically, depending on which technology is being employed. Distance education today ranges from home correspondence courses to live, interactive television instruction (Sukow, 1992). Live, interactive televised instruction is that which is offered in real time to students who have immediate talk-back capability with the instructor (Commission on Colleges, SACS, 1993). The use of instructional television is widespread, and experience with this medium spans a period of more than 20 years. The Association for Graduate Education and Research of North Texas (TAGER) was one of the first networks established to offer higher education to remote sites (Whittington, 1987). Maher (1984) reports that 101 colleges and universities held FCC instructional television fixed systems (ITFS) licenses in 1982. This represents almost 40 percent of the ITFS licenses which had been issued at that time.

In 1987, fewer than 10 states invested in distance learning at the K-12 level. Just one year later, two-thirds of the states reported some involvement. Experts expect the

trend to continue (McLarin, 1990). "We will see a time, very soon, when we will have teaching via technology as part of the educational curricula across the country," says Rich Gross, dean of telecommunications at Kirkwood Community College in Cedar Rapids, Iowa. "This is not a flash in the pan" (McLarin, 1990, p. 11).

As history has shown, educators have been finding ways to connect geographically separated teachers and students since correspondence courses became the vogue in the early 1800s. The mail was reliable and far-reaching, if not exactly glamorous. Today, with advances in technology, a teacher in Connecticut can reach a California student through a telephone line, a computer screen, or a satellite hovering 22,000 miles above the Earth. This ability could make distance education the biggest thing to hit American schools since the computer (McLarin, 1990).

Distance education is facilitated by an organization that develops educational media to unite teacher and learner and provides appropriate evaluation of the learning (Verduin & Clark, 1991). Some of the methods of delivery in distance learning include broadcasting, interactive television, video cassettes and disks, cable, and satellite. Of these methods, interactive television appears to hold the greatest potential toward meeting the concept of distance learning from educational institutions to off-site locations (Britton, 1992).

### Evolution of ITV

Television is a video medium with great potential as a distance delivery mode. It is used in a bewildering variety of ways, both in distance and conventional education. Visual media can be traced back to still pictures, the oldest form of recorded media. For many years, still pictures have been combined with print in texts. With the invention of photography in the early nineteenth century, illustrations in text gained accuracy and realism. The development of motion pictures in 1884 and of talkies (with sound added) in 1926 led to the widespread use of film in education after World War II. Television, invented in 1926, also blossomed as an educational medium during the postwar era (Verduin & Clark, 1991).

Instructional television has been used for decades. Currently hundreds of such systems, ranging from the simplest single-campus closed-circuit television systems to nationwide networks, link dozens of campuses (U.S. Congress, 1989). Instructional television can be divided into two categories: telecourses and interactive televised instruction (Schmidt & Faulkner, 1989). Telecourses are pre-produced television programs; interactive televised instruction is delivered in real time to students who have immediate talk-back capability with the instructor (Commission on Colleges, SACS, 1993).

Many of the interactive television technologies use one-way video, that is, students at remote sites can see the instructor at the originating or "local" site, but the instructor cannot see the students. Return audio links from remote sites to the instructor may be provided, usually via telephone, to permit students to ask questions and interact with the instructor (Simpson et al., 1993).

Two-way video with two-way audio (2V/2A) is primarily a conferencing medium, but is being used increasingly in education. This 2V/2A system permits students to see and hear the instructor and the instructor to see and hear the students. Sites usually have multiple cameras and can switch among them.

Multi-channel two-way video with two-way audio (2V/2A +) is a logical extension of 2V/2A in which each video source is transmitted on a separate channel instead of switched on a single channel. Thus, for example, a remote class would observe the instructor on one television display, graphics on a second, and other students on a third. The attributes of a 2V/2A + system differ from those of a 2V/2A system in that video is in the first case continuous and in the second switched, and 2V\2A + is more costly than 2V\2A.

One-way video with two-way audio (1V/2A) is more widely used in education. With this system students can see and hear the instructor, but the instructor can only hear, not



see, the students. One-way video with two-way audio is generally less costly than 2V/2A because remote sites do not transmit video but only audio, reducing communication cost greatly (Simpson et al., 1993).

Interactive television increases the availability of educational opportunities in various locations. It permits both the teacher and the participants in different locations to interact during the instructional process (Britton, 1992). Robinson and West (1986) pointed out that "interactive television has been successfully integrated into education systems and is a cost-effective means of augmenting the quality of education available to students, especially in rural areas" (p. 3).

Advanced levels of foreign languages, science, and mathematics could be made available via interactive television to students attending small schools who might not otherwise have access to such courses (Britton, 1992). "Where enrollments are low, where driving distances are prohibitive, where instructor time for off-campus instruction is not available, or costs of traditional off-campus instruction are prohibitive, telelearning should be considered as a desirable, effective alternative" (McMurray & Trott, 1987, p. 7).

Interactive television technology is applicable for courses using lecture or seminar formats, for professional training courses, and for continuing education courses.

Though certainly appropriate for sparsely populated areas, it is also appropriate in large metropolitan areas where traffic, parking, and other logistical constraints suggest that several learning sites may be simultaneously served by the same instructor (Magiera, 1994).

In recent years use of distance education technologies to deliver courses to students at all educational levels has increased greatly. A report by the U.S. Office of Technology Assessment, Linking for Learning: A New Course for Education (1989), examined the use of such technologies to improve the quality of education for students and training for teachers at the elementary and secondary (K-12) levels. At the time of the report, virtually every state was involved in distance education activities.

The state of Iowa is especially involved in distance education activity. The Iowa Communications Network (ICN) is a statewide two-way full motion interactive fiber optic telecommunications network with at least one point of presence in each of Iowa's 99 counties. The ICN links colleges, universities and secondary schools throughout the state and was constructed entirely with state and local funds. Construction of the fiber optic backbone portion of the network was completed during 1993. The ICN will ultimately connect hundreds of schools, colleges, regional libraries, and governmental agencies. In addition to the capability of transmitting up to 48 simultaneous video

channels, the ICN carries data and voice traffic (Simonson, Schlosser, & Anderson, 1995). As this network becomes operational, the state's colleges and universities can extend their campuses to reach smaller communities. Professionals such as doctors, lawyers, teachers, accountants, and others will be able to obtain required courses for continued certification without leaving their communities. State agencies will be able to conduct seminars and personnel training through the system. Elementary and secondary schools will be able to share resources and programs allowing for efficient use of limited resources. With this system, Iowa will be able to maintain and improve the type of education offered to its children and families. It will also enhance the economic environment within the state and provide opportunities for economic and academic growth and development (Schatz, 1993).

A dramatic expansion of distance learning through new technologies has occurred at colleges and universities all across the United States. In an article on information technology in The Chronicle of Higher Education, Robert Jacobson (1994) found the following:

Technology's growing capacity to facilitate instruction at remote sites could well produce a watershed for higher education in the 1990's. It is also clear from interviews with many distance-learning specialists and academic policy makers that they expect technology to

help colleges provide a wide range of programs, including undergraduate degree courses, to an increasingly larger part of the population --- and to do so, ultimately, for less money than it would take to build new campus facilities or hire new faculty members. (p. A19)

The idea that distance learning may soon become a major alternative to traditional campus programs has captured the attention of many people and organizations, from individual instructors and campus administrators to faculty unions, statewide coordinating boards, and regional accrediting agencies. In state after state, political leaders are providing funds to develop and augment distance learning networks. For example, Old Dominion University, a public institution in Norfolk, Virginia has moved ahead with plans to offer the last two years of undergraduate education to community-college graduates throughout the state over an interactive telecommunications network that initially will link 13 two-year institutions. Recently the state legislature awarded Old Dominion \$9.2 million to develop the network over the next two years, with an eventual goal of serving some 12,000 of an estimated 65,000 additional students a year who will be entering Virginia's colleges and universities by the end of this decade (Jacobson, 1994).

As the boom in distance learning progresses, many campus leaders expect more and more colleges to join

consortia or enter into agreements with other institutions, both inside and outside their states, in an attempt to impose some order. In Iowa, Rich Gross, dean of telecommunications at Kirkwood Community College, says "academic leaders should begin planning now for a time, perhaps as little as five years away, when distance learning will give most students virtually unlimited course options from institutions all over the world, regardless of where they may formally enroll" (Jacobson, 1994, p. A23).

Education is not the only field in which distance learning is booming. Porter (1990) reports that for a fast-growing number of companies -- more than 40 to date, including Hewlett-Packard, Eastman Kodak, Xerox, Federal Express, Domino's Pizza, and Aetna Life & Casualty -- training employees via live, interactive satellite television networks has become a way of life. Training employees via business television (BTV) is on the rise for several reasons. BTV networks enable the company's entire workforce, from headquarters to the field, to receive the same program at the same time. Unlike training tapes, BTV allows communication between the presenters and the audience. Companies able to train via BTV enjoy some distinct advantages. Porter (1990), an insurance executive, notes:

At Aetna, we've found that it's less expensive on a per-pupil basis to deliver a course by BTV than in

person. Even more important, BTV extends our reach, enabling us to deliver valuable training to employees who would not otherwise receive it. Without the Aetna Television Network, many of our field personnel wouldn't benefit from some of our courses, because of the time and expense involved in traveling to our home office in Hartford, Connecticut. (p. 73)

Because of the high transportation and hotel costs involved in flying field-office personnel to Hartford for training, courses can be delivered by BTV for just 10 to 30 percent of the cost of delivering them at the home office. BTV becomes even more attractive when considering all the productive hours employees lose when they are away from their offices (Porter, 1990).

Locally, First Tennessee Bank is taking advantage of the cost saving opportunities that interactive television can provide. Elizabeth Leach works in personnel at First Tennessee Bank here in Johnson City and is in charge of their interactive system. Ms. Leach says:

We have been using video conferencing with compressed video to transmit corporate meetings, statewide meetings, regional training meetings, employee training sessions, etc. for about one year now. With our headquarters in Memphis, and branches all across the state of Tennessee, we have realized much in cost savings with this interactive system. We are saving

\$600 per person in airline fees alone by not having to send people to Memphis for training. (E. Leach, personal communication, July 26, 1995)

It seems apparent from these reports that distance learning is the wave of the future. Not only is this technology being used extensively in public education and higher education, but it also becoming popular in big business. While the use of instructional television is growing at significant rates, is it an effective medium of instruction? Research has found conflicting results.

#### Positive Findings

The educational quality of the courses offered is a valid concern of decision-makers, educators, and students who participate in distance learning. Research does suggest that distance learning classes can be of the same quality as regular on-campus classes. Research into the effectiveness of televised instruction has provided evidence that results in achievement are comparable to results from face-to-face instruction.

At the postsecondary level, a number of studies have been conducted to evaluate the educational effectiveness of various technologies. Many have focused on the achievement of students in distance education and traditional classrooms. "Almost without exception such studies have shown that students taking courses via distance education technologies achieve as well as students taking courses via

traditional methods" (Kendall & Oaks, 1992, p. 3). The following are reviews of such studies.

McKell, Hardy, and Stocks (1992) discussed their presentation of a managerial accounting course on IBM's Corporate Educational NETwork (CENET). The course, broadcast via satellite, used one-way video and two-way audio communication with the students. The researchers concluded that the overall educational experience for the student was "very comparable to - or even better than - that found in the traditional classroom" (p. 97).

Instructional television classes are scheduled each semester in several disciplines at Chadron State College in Nebraska. Survey results indicate acceptance of the technology from the sites and that no significant difference exists in average grade point average between students at the originating broadcast site and students at the remote sites (Magiera, 1994).

In a study conducted by Ritchie and Newby (1989) twenty-six college undergraduates were randomly assigned to one of three treatment groups: (a) traditional classroom in the presence of an instructor, (b) television broadcast studio classroom in the presence of an instructor (live studio), and (c) studio classroom with television monitors instead of an instructor (distance). The instructional materials consisted of a thirteen-minute lecture about nominative absolute clauses. Practice was provided during



instruction as the instructor elicited responses from the subjects via telephone. After instruction, performance tests were administered to the subjects. Multiple-group comparisons showed the distance group scored significantly higher than the studio group, while those in the traditional group did not differ from either of the other two groups.

The Oklahoma Televised Instruction System links Oklahoma's public and private colleges and universities, junior colleges, and technical institutions. All programming is transmitted live from regularly scheduled on-campus classes. The signal that originates in the campus studio classroom is routed through the closed-circuit network to the distant site. The talkback from the remote sites is transmitted to the on-campus studio classroom via microwave radio or leased telephone lines. In a study to evaluate this system, comparisons of remote versus on-campus achievement were made in various subject areas. When comparing the performance of the two groups by area of study, significant differences were found among those students enrolled in business courses, with the distance students out-performing the on-campus students. No differences were found between the two groups of students in engineering, education, math and science, and social science courses (Dillon, Gunawardena, & Parker, 1992).

Pirrong and Lathen (1990) conducted a study at Boise State University to determine if significant differences

existed in business students' performance and attitudes when the classroom setting was a remote site interactive television classroom compared to a traditional classroom or a classroom in which the interactive broadcast originated. Instruction was given using one-way video and two-way audio. There were no significant differences among the three groups in student performance, and a large majority of the remote site students liked the overall system sufficiently well enough to take additional interactive television courses.

In a study of the effectiveness of a telelecture course taught to continuing education students at remote sites from Moorehead State University, on the Minnesota-North Dakota border, Beare (1989) found no differences in course achievement between students on campus and students at the sites. The distant learners found the course just as stimulating, were equally interested in the subject matter, and judged the instructor equally as skilled as did those receiving face-to-face instruction.

California State University-Chico has been using interactive television for more than ten years. Over 50 courses are offered each academic year and over 70 hours of university course work are broadcast per week. Instructors and administrators have found this method of delivery both academically effective and economically efficient (Whittington, 1987).

A report by the California Postsecondary Education Commission issued in 1979 states that "remote mediated learning combined with appropriate contact with live instructors and peers, can be at least as effective and significantly less costly per unit than traditional lecture modes" (Whittington, 1987, p. 51).

Souder (1993) compared the effectiveness of traditional versus distance (satellite-delivered) instruction in three master's degree programs. Traditional classroom instruction was used to teach students at the Georgia Institute of Technology (GaTech) and the University of Alabama in Huntsville (UAH). Students enrolled in the National Technological University (NTU) in Fort Collins, Colorado received the same instruction via satellite. NTU students could see the instructor and the classroom, and could ask questions or interact with all parties during the broadcasts through voice amplified telephone lines. All three of these courses were taught by the same instructor. On the final exam, mean exam scores for all three groups were quite high with each group scoring more than 90 on a 100-point scale. However, the NTU (distance) students scored significantly higher on the exam than the GaTech students. The UAH students' scores fell in the middle. This study adds to the evidence that distance learners should not be viewed as disadvantaged in their learning experiences. Souder also noted that the impact of distance education transcended

achievement and afforded other significant benefits. "The distance learners gained a broadened network of valuable colleagues, skills in working with others and collaborating across distances, and many social skills beyond those offered by traditional classroom settings" (Souder, 1993, p. 50).

Thomas L. Russell, director of instructional communications at North Carolina State University, has completed exhaustive reviews of the distance education literature in higher education. His reviews have pointed to case after case in which researchers could find no significant difference in how well students had learned with a variety of instructional approaches (Jacobson, 1994). Russell (1992) stated that, "No matter how it is produced or delivered; whether it is interactive, low-tech or high-tech, students learn equally well with each technology and learn as well as their on-campus, face-to-face counterparts" (p. J-3).

Distance education via instructional television is effective at the public school setting also. For some students the television generates its own excitement. "'It's easier than when the teacher is standing up in front of you,' says Anisha Hopewell, age 14" (McLarin, 1990, p. 11).

In Bergen County, New Jersey, Bell Atlantic is participating in a distance learning project linking 50

schools over a two-way interactive, fiber optic network. The program's goal was to extend the county's foreign-language and other courses to all of its students. What they have found is that it also has influenced how the students behave in the class. Teachers reported that students are more attentive, they are better prepared, and they are more articulate than they used to be (Sukow, 1992).

In January 1989, the Green Bay area public schools began broadcasting instructional television programming over the Green Bay area ITFS system, a two-way audio and one-way video interactive system. During their pilot semester advanced placement calculus was broadcast live each morning to 22 high school students in six rural districts outside Green Bay. Evaluations from students at the end of the calculus course indicated there were plenty of opportunities for students to ask questions of the instructor during class. These calculus students found their distance education opportunity to be a very valuable learning experience in which they would not normally have had the opportunity to participate (Burke, 1991).

In 1982, the College of Community Health Sciences at the University of Alabama implemented the Biomedical Sciences Preparation Program (BioPrep), an intervention program targeting students in rural Alabama high schools in grades 8-12. In 1989 a BioPrep anatomy and physiology course was adapted for interactive satellite delivery.

Course segments were broadcast live and featured interactions between the instructor and the students, who were able to view the lecture and use a cordless telephone to talk to the instructor. A study was conducted to determine, through measures of student achievement, the effectiveness of interactive satellite delivery as compared to the effectiveness of traditional classroom instruction. Results showed that students enrolled in the satellite-delivered anatomy and physiology course scored significantly higher than students in a traditional classroom setting. Also, the attitudes of students receiving distance instruction were not significantly different from attitudes of students receiving traditional classroom instruction (Martin & Rainey, 1993).

In a survey of three high schools that used an interactive instructional television system, Nelson (1989) reported that the students perceived little difference in the interactive television class and the traditional classroom. In addition, the teachers involved reported no significant differences in the students' test scores, grades, and participation when comparing sections of interactive television classes and classes taught in the traditional classroom.

In a review of the literature on technology and distance learning, Timpson and Jones (1989) report that small schools are turning to alternatives to meet curricular

needs "when neither student numbers nor local tax base have allowed for traditional solutions" (p. 10). Various organizations have moved to try to fill this need, especially in the areas of science, mathematics and foreign languages. Evaluations of the effectiveness of this kind of distance learning show no significant differences when compared with traditional in-class instruction. Timpson and Jones (1989) go on to assert that distance learning also fits into the currently popular concern for more choice for students and parents, especially for those students who have been historically underchallenged, i.e., the gifted and talented.

Although much of the research has shown interactive television to be an effective method of delivering courses to students in both higher education and public school settings, not all of the literature reports positive findings. Whittington (1987) concludes: "The educational effectiveness of televised instruction continues to be questioned despite widespread and increasing use of the medium in a broad range of instructional settings and in a variety of technological formats" (p. 47).

#### Negative Findings

Televised instruction has several shortcomings. While the television mechanism can be used in a wide variety of classes, it may foster passive instruction. Bloom (1984) found that all too many television instructors conduct their

classes by lecturing for the most part, failing to call on students, and failing to interact with the students at the remote sites in particular. He found an impersonal aspect to television instruction which discourages communication between students and faculty. "Because it is cumbersome to push buttons and use the telephone before speaking, students at the remote sites almost never get answers to the questions that they have" (p. 5).

Bloom (1984) reports that another problem area concerns technical difficulties like audio static, dead microphones, inattentive technical staff, and the inadequate coordination between instructors and technical staff in the control room. This makes it difficult for television instructors to maintain their composure when so many things can, and often do, go wrong. Bloom thinks that while the need for consideration of alternative instructional media is manifest, television instruction is plagued with vexing problems. This medium constitutes a useful instructional tool that needs further refinement.

In a study evaluating the Oklahoma Televised Instruction System, Dillon et al. (1992) report a number of factors that hinder students' performance in ITV courses. Among the more formidable factors were: (a) technical problems associated with the telecommunications system, especially in relation to poor audio from the transmitting and receiving sites, (b) poor coordination at the remote



sites such as inadequate courier services which were not only late in delivering handouts, assignments and exams, but sometimes delivered them to the wrong site or lost them completely, (c) unruly behavior or idle talking by some students at the remote sites which hindered students from paying attention to the lectures, (d) the lack of interaction between students and content, that is, the lack of study skills and self-motivation, (e) students feeling uncomfortable using the phone, while others felt left out because they could not hear the on-campus students clearly, and (f) the lack of interaction with the instructor outside of class.

In a study by Martin and Rainey (1993) investigating the effects of interactive televised instruction on student achievement and attitude in a high school anatomy and physiology course, students were asked to list the advantages and disadvantages of distance learning. While the advantages outnumbered disadvantages, these factors were among the disadvantages listed: "no direct eye contact for students, ITV is not good for average or below average students, difficult to keep attention on television, difficult to call teacher, and difficult to do make-up work" (p. 59).

Egan, Welch, Page, and Sebastian (1992) completed a study in which they compared student attitudes toward distance and traditional education. When conventional

instruction was compared with live, interactive television, conventional instruction received significantly higher student ratings for organization of course and clarity of course content, relevance of course objectives to class sessions, integration of text and assignments, and value of visual materials and text screens. Students also rated conventional instruction superior in adequacy of presenter delivery and student interest.

In an experiment conducted to compare training effectiveness and user acceptance of live instruction and six different alternative instructional television technologies, Simpson et al. (1993) found the difference between live and all ITV to be statistically significant. On a 50-item multiple choice final exam, students in live classes scored about five points higher than ITV students, a substantial difference. They also found that remote students spent more time 'off task' than students in live classes. These findings suggest that these technologies have limitations as substitutes for live instruction.

Kromholz and Johnstone (1988) report that some ITV faculty members expressed their anxiety about teaching on television by ignoring the special demands of the studio setting and rejecting their off-campus students. Consequently, these off-campus students complained about faculty performance. These students also reported feeling

uncomfortable about using the telephone talk-back system to ask questions during classes.

Beare (1989) found that on-campus students in classes being broadcast via instructional television are vocal in their dislike of that medium. They resist speaking into microphones and they do not like the separation of instructor attention between the local and remote sites. He further stated that one night, when the electronic equipment failed temporarily, the class spontaneously cheered.

Brown (1988) states that, "All things being equal, face-to-face interaction is the preferred learning mode for most people. Television viewing represents passive learning and participants' cognitive engagement appears to wane over extended periods of viewing time" (p. 9).

Koontz (1989) reports on administrative barriers to the adoption of ITV in higher education. These barriers include the lack of budget allocations, the lack of understanding and motivation by administrators, and the lack of training for the professor and administrator in using instructional television in higher education. Koontz goes on to state:

The additional time spent with ITV subtracts from the time the professor would ordinarily spend in class preparation, student contact, and other professional duties. When faculty are evaluated by administration, the production of an ITV program or series is not considered equivalent to a published journal article or

book. With little or no recognition given, the professor must revert to the traditional norms of acceptance and recognition and publish in the traditional formats to be eligible for a merit increase. Negative feedback is also quite possible. Exposing one's teaching deficiencies before a peer group and administrators opens up the faculty member to even greater risks! (p. 47)

In the October 19, 1994 issue of The Chronicle of Higher Education, Thomas DeLoughry reported some problems with distance education in California. Robert Threlkeld, director of the Distance Learning Center at Cal State Polytechnic in Pomona, says that professors in his program have encountered problems in getting permission to use copyrighted material for videotaped classes. This is because "fair use" guidelines that educators agreed to when the Copyright Act was rewritten in 1976 place limits on the number of times copyrighted materials can be used in the classroom. Threlkeld feels a second issue in higher education is whether the time spent making a videotape and communicating with students on the telephone and via electronic mail is equal to time spent preparing and teaching a traditional course.

Concerning the role of the faculty member in distance education, Strain (1987) cautions that once equipped with distance education technology, especially satellite dishes

that allow one instructor to reach hundreds of students, schools may see the system as a way to replace faculty or reduce staff.

There is widespread faculty concern that distance technology could be used to reduce higher education's costs without necessarily improving its quality. Jacobson (1994) found that this view is shared by leaders of United University Professions, a union representing some 21,000 faculty and staff members at 29 state-operated State University of New York (SUNY) campuses. Union officials also sense that an expansion of distance learning could threaten their members' job security and working conditions.

So, is interactive television a tool of the devil, or is it the world's next wonderful technological breakthrough? "The truth is, there is no conclusive evidence of any particular subject being unsuccessfully taught via television. Therefore, any subject can be taught if the teacher believes it can" (Russell, 1992, p. J-4). Effective instructional design and techniques are the crucial elements in student achievement whether instruction is delivered by television or by traditional means (Wolcott, 1993).

#### Instructor Effectiveness

Television is no more than a communication device that transmits instruction from one place to another. Clark (1983) says, "The best current evidence is that media are mere vehicles that deliver instruction but do not influence

student achievements any more than the truck that delivers our groceries causes changes in our nutrition" (p. 445). The critical factor in determining student achievement is the instruction itself. "Televised instruction is neither superior nor inferior to traditional classroom presentation. The question is not which medium works best, but what is effective instruction?" (Whittington, 1987, p. 54).

If distance teachers are to provide effective instruction through interactive technologies, then it is no longer possible to merely translate a traditional on-campus course to a distance setting and teach it the same way it was taught on campus. New paradigms must be developed for design of two-way interactive technologies (Gunawardena, 1992). Magiera (1994) reports that teaching a class via interactive television is different from teaching a regular class. The instructor must adapt to being on camera and dealing with the necessary equipment. He or she must be better prepared and organized and may have to learn new teaching strategies. "In most instances, changing teaching style may mean changing our underlying philosophy, beliefs about teaching, and perceptions of interpersonal interactions. This change will be no trivial matter for teachers because it may mean changing, to some extent, who we are as persons" (Gunawardena, 1992, p. 64).

Unlike traditional teaching, teaching through telecommunications requires the teacher: (1) to be sensitive

to the technical and communication problems students experience and make adjustments to solve them; (2) to plan for activities that would take place during technical failures and inform students of these plans at the beginning of the class; and (3) to prepare for course activities well ahead of time (Gunawardena, 1992).

Organizational skills, with attention to detail and previous planning, are essential for teaching a course using distance learning technology. The method prohibits the instructor from procrastinating and waiting until just hours before the class to engage in preparation (Fulmer et al., 1992). McLeary and Egan (1989) discuss the importance of quick feedback regarding student papers and quizzes. They found interactive television courses were rated much higher by students when instructors graded student materials quickly and returned them quickly.

Coordinating activities at the distant site is perhaps the most challenging task that distance teachers must accomplish. Unlike that of the traditional teacher, the role of the distance teacher has expanded, and the teacher no longer works alone but as a member of a team. Distance teachers need to work with support personnel and coordinators at the sites to arrange for an effective learning experience. This coordination can be excessively time consuming if several sites are involved. Unless the distance teacher makes a personal effort to coordinate

arrangements at the remote site and works as a team member, the distance learning experience may be a very unsatisfying one for many students (Gunawardena, 1992).

When using one-way video with two-way audio, the instructor has to create a high comfort level, so that students at the remote site do not hesitate to call when they have a concern. A high comfort level for students can be achieved only by instructors who themselves are comfortable on television. "They have to have developed the 'teletechniques' that such people as Johnny Carson, Oprah Winfrey, and Willard Scott have conditioned us to expect. When instructors are stiff and nervous, we tend to focus on their nervousness and not on the material" (Porter, 1990, p. 76).

Porter further advises that instructors must teach within the confines of the medium. They cannot move around as much as they can in a classroom, they cannot flail their arms, and they must speak more slowly. When they call on students, it is by phone. The person they are speaking with is someone neither they nor the other students can see. The following instructor skills are required: concentrating on and understanding what the caller is saying, remembering the student's multiple-part questions, and paraphrasing questions or statements for others to understand. When teaching via interactive television, instructors have to repeat information more frequently than in a traditional



classroom. The old Army training technique applies well here. "Tell 'em what you're gonna tell 'em, tell 'em, and then tell 'em what you told 'em" (Porter, 1990, p. 76). Regular summaries help to maintain concentration and reinforce learning. Subtlety is not compatible with television training. Whenever the instructor moves into a different subject area, he or she needs to clearly state that one topic has been completed, another is about to begin, and that a third one will follow.

The instructor must constantly use communication skills which reinforce that the off-campus students are an integral part of the class. Initially, an explanation of how the system works, with an orientation to equipment, especially the cameras, is advantageous for both students and the instructor. Because eye contact is a basic skill in communication, the instructor must remember to look directly at the camera in the rear of the room when addressing students on the off-campus site. Also, calling unseen students by name transmits respect and decreases depersonalization. Just as humans are not perfect, technology is not perfect. Technical difficulties can occur and interrupt the teaching-learning process. The instructor must be flexible and adapt to these infrequent unpredictable occurrences (Fulmer et al., 1992).

"The biggest frustration I have experienced as a distance teacher has been the lack of recognition for the

amount of time and effort that goes into planning and teaching a distance class" (Gunawardena, 1992, p. 70). Gunawardena goes on to say that current academic reward systems do not recognize the distinction between traditional on-campus and distance teaching. If faculty are not given incentives for the extra planning and effort that goes into arranging distance learning experiences, then motivation to continue to teach at a distance and to recruit others to the field will decrease. Distance teaching should be rewarded in the tenure and promotion system to encourage faculty to teach at a distance and to experiment with new technologies and methods of teaching. Other incentives that could be considered are adjustments in faculty course loads, the support of graduate assistants, or monetary rewards.

In regard to training faculty to teach on ITV, Simpson et al. (1993) found that instructors gained skill and confidence in the ITV classroom rapidly. After training, all instructors observed appeared comfortable after only a few hours and skilled before the camera in about two weeks. Instructors interviewed expressed their preference for teaching in ITV classrooms that permitted two-way video rather than one-way video. It appeared to take instructors slightly longer to adapt to one-way video than two-way video.

Kendall and Oaks (1992) did a study in which they gathered responses over three semesters from 46 faculty

members who taught via the Washington Higher Education Telecommunication System (WHETS), a video interactive television system, to evaluate their perceptions and satisfaction. In considering their teaching strategies, the majority of faculty members perceived lecture, question/answer, and case studies as more or equally effective over WHETS in comparison to a traditional classroom setting. Group discussion and seminars were rated as less effective by a majority of faculty. The loss of active involvement with students that instructors would normally experience in a traditional classroom was the major concern faculty had. Most faculty were equally or better satisfied with teaching via WHETS. Ninety-six percent of the faculty said they would teach over WHETS again if asked. Personnel working with the WHETS faculty recommended that faculty members consciously implement strategies that would enhance interaction between instructors and students at off-campus sites.

From observations and interviews with distance education students at Utah State University, Wilkes and Burnham (1991) found that interactive television exaggerates an instructor's weaknesses. "If instructors are boring in a face-to-face setting, they can reach undescribable depths of insipidity coming across the phone lines. A monotone voice is harder to concentrate on when coming from a distance than it is coming from within the same room" (p. 49). The

teacher is still an important element in any distance education system. Perhaps too much attention has been placed on the hardware and not enough on the human element and the teacher. People are the key to success in distance learning. These include motivated students, flexible on-campus faculty, and knowledgeable telecommunications personnel (Fulmer et al., 1992).

Researchers in telecommunications have suggested that the effectiveness of mediated transmission is influenced by the degree of "social presence" conveyed. Social presence refers to the ability to approximate the characteristics of face-to-face interaction (Short, Williams, & Christie, 1976). Clearly, televised classrooms are not as socially present as face-to-face classrooms. Therefore, it is likely that learning and satisfaction in the televised classroom would be enhanced by strategies that increase perceived social presence. One set of behaviors that might convey social presence in the televised classroom are behaviors that "enhance closeness to and nonverbal interaction with another" (Mehrabian, 1969, p. 203).

In a study on the effects of instructional communication in the televised classroom, Hackman and Walker (1990) found that student satisfaction with televised courses was correlated with the teacher doing the following: using personal examples, encouraging students to participate, using humor, addressing students by name,

providing individual feedback, praising students, smiling, avoiding tense body positions, and using vocal variety. Distant students at the sites were more likely to feel a sense of rapport with in-class students when the instructor smiled and encouraged those off-campus to talk. Martin and Rainey (1993) found interactive television courses that were rated positively had these student comments: "Instructors were nice, patient, thorough, smart, and understanding." Students further stated that "their teachers had an enthusiastic style that kept the class alive and that instructors humanized classes with humor" (p. 55). Dillon et al. (1992) found that off-campus students rated ITV favorably when instructors were willing to explain things more than once and when instructors gave personal attention to students at the remote site.

In short, if the instructor makes distant students feel connected to the class, adopts nonverbal behaviors that are relaxed and natural, uses humor, and is willing to explain things more than once, the televised experience is more positive for off-campus learners.

So, is interactive television an effective way to provide instruction to students at distant locations? Walker, Hackman, and Eames (1989) believe the students should be the judge:

The only reasonable basis for summative evaluation of ITV effectiveness rests with the student's perception

of content utility and satisfaction with conveyance. It is the student who must make the ultimate decision of whether telecourse alternatives offer acceptable trade-offs for the anticipated sacrifice of limited social networking and interaction. (p. 15)

### Distance Students

In distance education the person, persons, or institutions providing instruction are separate either in place or time, or both, from their learners. Moore (1987) feels that since distance learning requires a fairly high degree of self-motivation and self-discipline, it is more suited to adult learners than to younger learners. Moore found that in many countries methods of distance education are being used to meet the higher and continuing education needs of adult learners at off-campus locations.

Holmberg (1989) found that distance students share some common factors. In most educational institutions these students are adults who are gainfully employed and/or take care of a family, with the largest representation of distance students falling in the 25-35 age bracket. A more recent investigation describes the successful distant student as being over 25 years old, married, and female (Bink, Biner, Huffman, Geer, & Dean, 1995).

Verduin and Clark (1991) believe that distance education may be classified as a form of adult education.

They report the following adult education characteristics of distance education:

1. Time and place. The choice of time and location in distance education appeals to working adults.
2. Traditional affiliation. Distance education has traditionally been offered through the continuing education and extension units of colleges and universities as a part of the outreach programs of these institutions. These off-campus units generally provide services for adults, not children.
3. Literature. Articles, books, and other documents about distance education largely concern programs in which adults are the principal market.
4. Learner traits. Successful study at a distance requires certain traits that are more typical of adult than of pre-adult learners. The ability to be self-directed and internally motivated can affect a learner's satisfaction and likelihood of completing a program. (p. 4)

Students entering a learning situation differ in maturity. Hersey and Blanchard (1974) have referred to this type of maturity as "the level of achievement-motivation, willingness and ability to take responsibility, and task relevant education and experience of the individual or group" (p. 28). Generally, nontraditional students who are older can enter a learning situation with more motivation

and more relevant experience. Hersey and Blanchard found that nontraditional students were more likely to desire to set their own direction for the learning experience. This learner-centered approach would require less leadership on the part of the instructor.

It follows then that nontraditional students would do better in a distance education setting due to their learner-centered style of learning. In a study of the Washington Higher Education Telecommunication System, which is an interactive system, faculty were asked to describe off-campus students in comparison to on-campus students. The faculty was nearly unanimous that off-campus students were older, more motivated, and had a higher achievement level than on-campus students (Kendall & Oaks, 1992).

As the population has aged and nontraditional attendance in college has become more common, adult education has become a larger factor in higher education. "Students 25-years-old or older made up 38 percent of college enrollment in 1977 and 42 percent in 1987. Nontraditional students are expected to account for more than 45 percent of college enrollment by 1997" (Verduin & Clark, 1991, p. 6). This trend has been reflected at ETSU. The Center for Adult Programs and Services at ETSU defines the nontraditional student as someone age 23 or older. Nontraditional student enrollment has grown from 44 percent in 1990 to 54 percent in 1994 (ETSU Fact Book, 1994).



Because work schedules or leisure time activities can conflict with on-campus class participation, adults often find distance education more viable.

However, not all learning at a distance takes place in the traditional form of higher education. More than 90 percent of distance education enrollment in the United States occurs through postsecondary institutions other than colleges or universities (Ludlow, 1987). In the US Air Force alone, some 400,000 persons undertake continuing education through distance technologies. These are nearly all programs of a training nature. Some 200 of the Fortune 500 corporations use distance education in their in-house training programs (Moore, 1989a).

Thus, distance education is a means of empowerment for the person from any walk of life who wishes to continue in academic study and for the worker who requires knowledge of new techniques to maintain or change employment. Distance education makes almost any subject available to the individual learner in the most solitary of geographic locations and to all those who prefer to control the timing, location, and place of their study. Some researchers believe that "motivated students learn from any medium and that, in many instances, students learn not from the medium or system used, but in spite of it" (Wilkes & Burnham, 1991, p. 43). People are the key to success in distance learning, and this includes motivated students (Fulmer et al., 1992).

### Summary

Television instruction provides an exciting challenge to administrators, faculty, and students. The expanding information age beckons us to consider mechanisms for using communication technologies for the benefit of lifelong learning. A cost-effective way to deliver courses is through interactive television. Interactive communication presents both potential and promise for meeting the needs of distance learning. Martin and Rainey (1993) found research on the effects of distance learning on student achievement and student attitude to be limited. They identified the need for additional research to be conducted with different populations. Further, the effects of distance instruction in higher education courses such as chemistry, physics, and mathematics need investigation (Dillon et al., 1992).

This review of literature has presented a comprehensive overview of distance learning from the aspect of history, evolution of ITV, positive findings, negative findings, instructor effectiveness, and distance students. The review of literature highlights conflicting opinions about the usefulness and effectiveness of interactive television in the general classroom. None of the studies specifically focused on developmental algebra classes at the university level. This study examined the effectiveness of using an interactive television system to broadcast developmental algebra classes at the university setting.

## CHAPTER 3

### Methodology

This section presents an overview of the research methodology used in this study. It includes the research design, description of the variables, population, sample, instrumentation, data collection, control for extraneous variables, and data analysis.

#### Research Design

A quasi-experimental design was used in this study. This design is appropriate when random assignment of subjects to treatment groups is not possible (Borg & Gall, 1989). While this design compromises some of the rigor of the controlled experiment, it does maintain the argument and logic of experimental research. This type of research has also been called "ex post facto research," a systematic empirical approach in which the investigator does not employ experimental manipulation nor random assignment of subjects to conditions because events have already occurred or they are inherently not manipulable (Rudestam & Newton, 1992).

#### Variables in the Study

The independent variable in the study was the method of delivery to students at the three instructional sites -- ITV host site, ITV remote site, and traditional classroom.

The age of each student was a classifying independent variable. The dependent variables in the study were each student's final course grade and attitude toward taking another ITV class in the future. Another variable used in the study was each student's score on a proficiency test given at the beginning of each semester. This proficiency test score was used as a covariate to control for any preexisting differences among groups prior to the research.

#### Population

The target population being studied was developmental algebra students at East Tennessee State University. Developmental studies programs attempt to form a bridge between high school and college mathematics. All Tennessee Board of Regents (TBR) schools offer developmental studies courses. Developmental students meet admission standards but have an American College Test (ACT) composite score less than 19, or a subscore in math below 19. Equivalent Scholastic Aptitude Test (SAT) scores are a composite of 740 or less, or math scores of less than 390. Students are placed into a developmental algebra course based on their scores on the Academic Assessment and Placement Program (AAPP) test. Developmental courses give credit, but the credit is added onto degree requirements (TBR AAPP Student Information Bulletin, 1994).

### Sample

A cluster sampling technique was used in this study. In cluster sampling the unit of sampling is not the individual but rather a naturally occurring group of individuals. Cluster sampling is used when it is more feasible or convenient to select groups of individuals than it is to select individuals from a defined population (Borg & Gall, 1989).

For the purposes of this study, the sample was made up of all developmental students at ETSU enrolled in an Introductory Algebra course or an Intermediate Algebra course taught via ITV during the following seven consecutive semesters: Spring 1993, Summer 1993, Fall 1993, Spring 1994, Summer 1994, Fall 1994, and Spring 1995. The researcher was the instructor for all of these classes. The sample also included developmental students at ETSU enrolled in an Introductory Algebra course or an Intermediate Algebra course taught in this instructor's traditional classrooms during these same semesters. Over the period of these seven semesters, 189 students were enrolled in the Introductory Algebra course under investigation, and 112 students were enrolled in the Intermediate Algebra course under investigation. Table 1 presents the Introductory Algebra enrollments by semester/year and by method of instructional delivery. Table 2 presents the Intermediate Algebra enrollments by semester/year and by method of instructional

delivery. Of the 189 Introductory Algebra students, 89 were traditional age (22 and younger) and 100 were nontraditional age (23 and older). Of the 112 Intermediate Algebra students, 42 were traditional age and 70 were nontraditional age. Table 3 presents the Introductory Algebra enrollments by student age and method of instructional delivery. Table 4 presents the Intermediate Algebra enrollments by student age and method of instructional delivery.

Table 1

Introductory Algebra Enrollment by Method of Instructional Delivery

Semester and Year	ITV Host Site	ITV Remote Site	Traditional Classroom
Spring 1993	17	16	29
Summer 1993	10	5	
Fall 1993	16	3	18
Summer 1994	18	3	
Fall 1994	14	14	26
Totals	75	41	73

Table 2

Intermediate Algebra Enrollment by Method of Instructional Delivery

Semester and Year	ITV Host Site	ITV Remote Site	Traditional Classroom
Spring 1994	16	15	24
Spring 1995	18	15	24
Totals	34	30	48

Table 3

Introductory Algebra Enrollment by Student Age and Method of Instructional Delivery

	ITV Host Site	ITV Remote Site	Traditional Classroom
Traditional Age	32	15	42
Nontraditional Age	43	26	31
Totals	75	41	73

Table 4

Intermediate Algebra Enrollment by Student Age and Method of Instructional Delivery

	ITV Host Site	ITV Remote Site	Traditional Classroom
Traditional Age	15	11	16
Nontraditional Age	19	19	32
Totals	34	30	48

The students in this sample were given math instruction by the same teacher at one of three sites:

1. ITV Host Site - This was an interactive television studio (housed in room 123 Sam Wilson Hall) located on the main campus of ETSU. Students in this setting were given instruction in a room equipped with cameras and microphones at each desk. The instructor was physically present with these students. Math instruction was given on camera, with the students seeing the problems worked by the instructor on two overhead television screens. Instruction originated in this on-campus studio and was transmitted to another group of students in Kingsport, Tennessee (remote site).
2. ITV Remote Site - The students in Kingsport were the second group in the study. They were part of this live, interactive instruction. They could talk to the instructor via cordless telephone at any time during the class. The students in Kingsport saw (via television) and heard everything that was going on in the on-campus studio. However, the students and the instructor at the on-campus site could only hear the students in Kingsport (two-way audio but only one-way video). A faculty assistant was always present with the students in the ITV remote site. This person monitored the television equipment, kept class attendance records, and proctored exams.
3. Traditional Classroom - Students in this setting were taught algebra in a regular classroom. The teacher was



present with the students and instruction was given using the chalkboard.

The students in these three groups had comparable levels of math skill. Students were placed in either the Introductory or Intermediate Algebra course based on their score on the AAPP exam. As a second check in making sure students were placed properly, a 10-problem proficiency test was given on the first day of each class. This test covered the objectives that would be taught throughout the semester. Student scores on this proficiency test could range from 0 to 100. If students scored 70% or higher on the exam, they were "bumped up" to the next level math course. This proficiency exam helped to ensure that students were equitable mathematically from the beginning of the course. The proficiency exam scores were used as a covariate in the study to control for any preexisting differences among groups prior to the research.

#### Instrumentation

Both the Introductory Algebra and Intermediate Algebra courses met three hours a week for 15 weeks during the Spring and Fall semesters in which they were taught. Summer courses met for 7.5 hours a week for five weeks. The instructor for all of these courses was Sherri Hodge-Hardin. The same syllabus and text were used in all Introductory Algebra classes, and the same syllabus and text were used in all Intermediate Algebra classes. Copies of the course

syllabi are found in Appendix A. The textbook used for both courses was Intermediate Algebra (6th edition) by Miller, Lial, and Hornsby (1992). The first four chapters of the text were covered in the Introductory Algebra course, and chapters five through eight were covered in the Intermediate Algebra course. The HarperCollins test generator that goes along with this text allows instructors to create and print tests for mathematics courses. During the product development, the test generator program and the testbank data were tested for reliability and accuracy by being subjected to *alpha*, *beta*, and *gamma* testing (C. Schultz, personal communication, February 24, 1995).

The same test generator program has been used by HarperCollins for almost 10 years with new features being added every year. Each new version of the program is programmed according to written specifications that show screen displays and describe all the functions available in specific portions of the program. The program is tested thoroughly by the programmer before sending the new program on disk to the publisher. This is known as *alpha* testing. The publisher tests the new program to make sure it does what it is supposed to according to the written specifications, noting any errors in execution, branching, user interface, or display. This is known as *beta* testing. The publisher prepares a written report of the errors and sends it to the programmer who makes the corrections on the

disk and returns the program for more testing. The cycle of publisher testing and programmer corrections continues until no more errors are found. This is known as *gamma* testing. At some time during the *beta* and *gamma* testing, the program is sent to additional reviewers and testers, usually professors, who agree to work with the program and report any errors they find. These comments are included on the reports to programmers. Since the program has been built over time and uses the same basic programming routines for number generation and calculation, it becomes more reliable as time goes on (C. Schultz, personal communication, February 24, 1995).

Students in all classes were given four exams and a comprehensive final, each of which comprised 20% of the student's grade. Exams for each class were graded by the instructor. The same concepts were covered in all Introductory Algebra classes, as well as all Intermediate Algebra classes. Final grades were calculated for each student in all classes based on a 100-point scale. This numerical final grade was used as a dependent variable in determining the effectiveness of these ITV courses.

Student attitude toward taking another ITV course was another dependent variable in this study. During the final exam, students enrolled in the ITV classes were asked to check 'yes' or 'no' to two questions that were attached to their exam: (1) Would you take another math class taught

via interactive television? and (2) Would you take any other class taught via interactive television? A copy of the final exam for each course is found in Appendix B.

#### Data Collection

All data were collected throughout the seven semesters in which ITV classes were being taught. Students at the ITV host site and ITV remote site took all exams at the same time. The classroom facilitator in Kingsport proctored all exams. Completed exams were sent back to the instructor through the ITV courier service. The instructor graded all exams personally. The ITV host site and remote site received their graded tests within two to three days after the exam. At the end of each semester final course grades (based on a 100-point scale) were calculated for each student by the instructor. Final grades reflected four exams and one comprehensive final. All five grades were weighted evenly. Attached to the final exam was a blank sheet in which students were asked to check 'yes' or 'no' to two questions concerning participation in future ITV courses. These sheets were separately collected from the final exams, and students were asked not to reveal their identity with their responses. Student age was determined from Developmental Studies records. However, no identification of students relative to their grades or age will be used.

### Control for Extraneous Variables

When experimental control is not possible, statistical control can be achieved by measuring one or more variables in addition to the independent variables of primary interest and by controlling the variation attributed to these variables through statistical analysis rather than through research design (Hinkle, Wiersma, & Jurs, 1988). Analysis of covariance (ANCOVA) is a control technique used in studies in which already formed, not necessarily equal groups are involved. ANCOVA is used as a technique for controlling extraneous variables and as a means of increasing power. Covariance is a form of analysis of variance (ANOVA) and is a statistical, rather than an experimental method that can be used to equate groups on one or more variables. Essentially, ANCOVA adjusts posttest scores for initial differences on some variable called the covariate, and compares adjusted scores. In other words, the groups are equalized with respect to the control variable (covariate) and then compared (Gay, 1992). Each student's score on the proficiency exam was used as the covariate in this study.

### Data Analysis

The data analysis includes both parametric and nonparametric procedures. A two-way analysis of variance with one covariate (ANCOVA) will be used to determine if differences in student achievement exist among the three

instructional sites. The ANCOVA procedure will also be used to determine if differences in student achievement exist among the three instructional sites when comparing traditional age students with nontraditional age students. Student achievement was measured by the final course grade and is ratio level data. The parametric ANCOVA procedure is appropriate when attempting to find significant differences among three or more groups using ratio level data. If differences are found to be statistically significant, a post hoc Tukey procedure will be used to determine which of the groups are contributing to the difference.

The answers to the two questions concerning future participation in ITV courses are 'yes' 'no' responses. As this is nominal level data, the nonparametric Chi-Square procedure will be used to determine if there is a significant difference in student attitudes toward enrolling in future ITV courses when comparing the host site with the remote site.

## CHAPTER 4

### Results of Data Analysis

This study focused on the achievement of three groups of developmental algebra students. The purpose of this study was to determine if there were differences in math achievement of students taught in an ITV class setting with the instructor present (Group 1 - host site), students receiving instruction via television at an off-campus location (Group 2 - remote site), and students taught in a traditional classroom setting (Group 3). This study also compared traditional students and nontraditional students to see if there were differences in achievement based on age, as well as the instructional delivery method. Finally, the researcher tried to determine if students who enrolled in a developmental algebra course taught via interactive television would consider taking another ITV course in the future, and if they would consider taking another ITV math course in the future.

Chapter four is a presentation of the results of the data analysis. Eight null hypotheses were tested in this study. These hypotheses are addressed sequentially. All testing for statistical significance was conducted using an alpha level of .05.

Null Hypotheses 1 and 2

H<sub>0</sub>1: There will be no significant differences in student achievement in Introductory Algebra using three different methods of delivering instruction: host site (ITV with the teacher present), ITV at remote site, and traditional classroom.

H<sub>0</sub>2: There will be no significant differences in student achievement in Introductory Algebra using three different methods of delivering instruction when comparing traditional students with nontraditional students.

Null hypotheses one and two were tested using a two-way analysis of variance with one covariate (ANCOVA). Two assumptions underlying the use of ANCOVA are: (1) the covariate must be linearly related to the dependent variable and (2) the regression lines for each of the individual groups must be parallel or they should have the same slope. This assumption is called homogeneity of regression or parallelism (Hinkle, Wiersma, & Jurs, 1988). In preliminary analyses the assumptions of linearity and homogeneity of regression were met. Therefore, the use of ANCOVA was appropriate in testing null hypotheses one and two.

In the ANCOVA procedure the independent variable was the method of delivery to students at the three instructional sites (Group 1 - ITV host site, Group 2 - ITV remote site, and Group 3 - traditional classroom). The age of each student was a classifying independent variable.



Students were coded as either traditional age (22 and younger) or as nontraditional age (23 and older). The dependent variable used in the ANCOVA procedure was each student's final course grade. The covariate was each student's proficiency test score. The covariate was used to control for any preexisting differences among groups prior to the research. Table 5 presents the results of the ANCOVA for Introductory Algebra.

Table 5

Analysis of Covariance on Final Course Grade by Group and Age for Introductory Algebra

Source	SS	df	MS	F	p
PROFTEST	31066.82	1	31066.82	14848.47	$\leq .0005$
GROUP	7.32	2	3.66	1.75	.177
AGE	.23	1	.23	.11	.739
GROUP by AGE	.72	2	.36	.17	.843
error	380.79	182	2.09	----	----

As seen by the  $p$  value on the variable labeled GROUP ( $p = .177$ ), there were no significant differences in student achievement among the three groups. The  $p$  value must be less than the alpha level of .05 for the groups to be considered statistically different. Thus, null hypotheses one was retained. There were no significant differences in

student achievement in Introductory Algebra using three different methods of delivering instruction: host site (ITV with the teacher present), ITV at remote site, and traditional classroom.

As seen by the  $p$  value on the variable labeled GROUP by AGE ( $p = .843$ ), there were no significant differences in student achievement among the three groups when comparing traditional age students with nontraditional age students. Again the  $p$  value of .843 is not less than the alpha level of .05. Thus, null hypothesis two was retained. There were no significant differences in student achievement in Introductory Algebra using three different methods of delivering instruction when comparing traditional students with nontraditional students.

Analysis of covariance is a statistical method used to equate groups on another variable called the covariate. Essentially, ANCOVA adjusts posttest scores for initial differences on the covariate and compares adjusted scores. In other words, the groups are equalized with respect to the covariate and then compared (Gay, 1992). In this study the ANCOVA procedure calculated observed group means on the dependent variable (student's final course grade) and it also calculated adjusted group means on the dependent variable. For the adjusted means the groups were equalized with respect to the covariate (student's proficiency exam score) and then group means were calculated. Table 6 gives

the observed group means on the dependent variable, final course grade. The three groups are subdivided into traditional and nontraditional age brackets. Table 7 gives the adjusted group means on the dependent variable, final course grade. These three groups are also subdivided into traditional and nontraditional age brackets.

Table 6

Observed Group Means on Final Course Grade for Introductory Algebra

	ITV Host Site	ITV Remote Site	Traditional Classroom
Traditional Age	87.231	87.800	82.286
Nontraditional Age	83.714	83.577	85.548

Table 7

Adjusted Group Means on Final Course Grade for Introductory Algebra

	ITV Host Site	ITV Remote Site	Traditional Classroom
Traditional Age	87.248	87.652	82.328
Nontraditional Age	83.705	83.663	85.491

The difference in the observed group means and the adjusted group means was very minimal. The covariate (student's proficiency exam score) did little in adjusting

final course grades. As can be seen from Table 7, the traditional age students at the ITV remote site in Kingsport had the highest group mean ( $\bar{m} = 87.652$ ) for Introductory Algebra. The traditional age students in the traditional classroom setting had the lowest group mean ( $\bar{m} = 82.328$ ) for Introductory Algebra.

#### Null Hypotheses 3 and 4

H<sub>0</sub>3: There will be no significant differences in Introductory Algebra student attitudes toward enrolling in future ITV courses when comparing the host site with the remote site.

H<sub>0</sub>4: There will be no significant differences in Introductory Algebra student attitudes toward enrolling in future ITV math courses when comparing the host site with the remote site.

The nonparametric chi-square procedure was to be used to test null hypotheses three and four. However, upon observation of the data there was no variation in the students' responses concerning future participation in ITV courses nor in their responses concerning future participation in ITV math courses. Students at both the ITV host site on campus and the ITV remote site in Kingsport overwhelmingly checked yes to taking future ITV classes and future ITV math classes. Table 8 gives the results of student responses toward taking another ITV class. Table 9

gives the results of student responses toward taking another ITV math class.

Table 8

Introductory Algebra Student Responses Toward Taking Another  
ITV Class

	ITV Host Site	ITV Remote Site
Students responding YES	75	40
Students responding NO	0	1
Percentage responding YES	100	97.6
Percentage responding NO	0	2.4

In Introductory Algebra of the 75 students enrolled at the ITV host site, 75 responded yes to taking another ITV class in the future. Of the 41 students enrolled at the ITV remote site in Kingsport, 40 responded yes to taking another ITV class in the future. Thus, in answer to the question "Would you take another class taught via interactive television?" ITV host site students' responses were: Yes - 100% and No - 0%. ITV remote site students' responses were: Yes - 97.6% and No - 2.4%. Therefore, there were no significant differences in Introductory Algebra student attitudes toward enrolling in future ITV courses when comparing the host site with the remote site.

Table 9

Introductory Algebra Student Responses Toward Taking Another  
ITV Math Class

	ITV Host Site	ITV Remote Site
Students responding YES	75	39
Students responding NO	0	2
Percentage responding YES	100	95.1
Percentage responding NO	0	4.9

The 75 students at the ITV host site unanimously responded yes to taking another math ITV class. Of the 41 students enrolled at the ITV remote site in Kingsport, 39 responded yes to taking another math ITV class. Thus, in answer to the question "Would you take another math class taught via interactive television?" ITV host site students' responses were: Yes - 100% and No - 0%. ITV remote site students' responses were: Yes - 95.1% and No - 4.9%. Therefore, there were no significant differences in Introductory Algebra student attitudes toward enrolling in future ITV math courses when comparing the host site with the remote site.

Null Hypotheses 5 and 6

H<sub>0</sub>5: There will be no significant differences in student achievement in Intermediate Algebra using three different methods of delivering instruction: host site (ITV with the teacher present), ITV at remote site, and traditional classroom.

H<sub>0</sub>6: There will be no significant differences in student achievement in Intermediate Algebra using three different methods of delivering instruction when comparing traditional students with nontraditional students.

Null hypotheses five and six were tested using a two-way analysis of variance with one covariate (ANCOVA). In preliminary analyses the assumptions underlying the use of ANCOVA (the assumptions of linearity and homogeneity of regression) were met. Therefore, the use of ANCOVA was appropriate in testing null hypotheses five and six.

In the ANCOVA procedure the independent variable was the method of delivery to students at the three instructional sites (Group 1 – ITV host site, Group 2 – ITV remote site, and Group 3 – traditional classroom). The age of each student was a classifying independent variable. Students were coded as either traditional age (22 and younger) or as nontraditional age (23 and older). The dependent variable used in the ANCOVA procedure was each student's final course grade. The covariate was each student's proficiency test score. The covariate was used to

control for any preexisting differences among groups prior to the research. Table 10 presents the results of the ANCOVA for Intermediate Algebra.

Table 10

Analysis of Covariance on Final Course Grade by Group and Age for Intermediate Algebra

Source	SS	df	MS	F	p
PROFTEST	13969.38	1	13969.38	6071.19	$\leq .0005$
GROUP	2.71	2	1.36	.59	.556
AGE	.05	1	.05	.02	.888
GROUP by AGE	7.33	2	3.67	1.59	.208
error	241.60	105	2.30	----	----

As seen by the  $p$  value on the variable labeled GROUP ( $p = .556$ ), there were no significant differences in student achievement among the three groups. The  $p$  value must be less than the alpha level of .05 for the groups to be considered statistically different. Thus, null hypotheses five was retained. There were no significant differences in student achievement in Intermediate Algebra using three different methods of delivering instruction: host site (ITV with the teacher present), ITV at remote site, and traditional classroom.



As seen by the  $p$  value on the variable labeled GROUP by AGE ( $p = .208$ ), there were no significant differences in student achievement among the three groups when comparing traditional age students with nontraditional age students. Again the  $p$  value of .208 is not less than the alpha level of .05. Thus, null hypothesis six was retained. There were no significant differences in student achievement in Intermediate Algebra using three different methods of delivering instruction when comparing traditional students with nontraditional students.

Again, the ANCOVA procedure calculated observed group means on the dependent variable (student's final course grade) and it also calculated adjusted group means on the dependent variable. For the adjusted means the groups were equalized with respect to the covariate (student's proficiency exam score) and then group means were calculated. Table 11 gives the observed group means on the dependent variable, final course grade. The three groups are subdivided into traditional and nontraditional age brackets. Table 12 gives the adjusted group means on the dependent variable, final course grade. These three groups are also subdivided into traditional and nontraditional age brackets.

Table 11

Observed Group Means on Final Course Grade for Intermediate Algebra

	ITV Host Site	ITV Remote Site	Traditional Classroom
Traditional Age	89.533	84.909	82.438
Nontraditional Age	87.474	92.105	83.562

Table 12

Adjusted Group Means on Final Course Grade for Intermediate Algebra

	ITV Host Site	ITV Remote Site	Traditional Classroom
Traditional Age	89.108	85.071	82.725
Nontraditional Age	87.809	92.011	83.419

The difference in the observed group means and the adjusted group means was very minimal. The covariate (student's proficiency exam score) did little in adjusting final course grades. As can be seen from Table 12, the nontraditional age students at the ITV remote site in Kingsport had the highest group mean ( $\bar{m} = 92.011$ ) for Intermediate Algebra. The traditional age students in the traditional classroom setting had the lowest group mean ( $\bar{m} = 82.725$ ) for Intermediate Algebra.

Null Hypotheses 7 and 8

H<sub>0</sub>7: There will be no significant differences in Intermediate Algebra student attitudes toward enrolling in future ITV courses when comparing the host site with the remote site.

H<sub>0</sub>8: There will be no significant differences in Intermediate Algebra student attitudes toward enrolling in future ITV math courses when comparing the host site with the remote site.

The nonparametric chi-square procedure was to be used to test null hypotheses seven and eight. However, upon observation of the data there was no variation in the students' responses concerning future participation in ITV courses nor in their responses concerning future participation in ITV math courses. Students at both the ITV host site on campus and the ITV remote site in Kingsport overwhelmingly checked yes to taking future ITV classes and future ITV math classes. Table 13 gives the results of student responses toward taking another ITV class. Table 14 gives the results of student responses toward taking another ITV math class.

Table 13

Intermediate Algebra Student Responses Toward Taking Another  
ITV Class

	ITV Host Site	ITV Remote Site
Students responding YES	33	29
Students responding NO	1	1
Percentage responding YES	97.1	96.7
Percentage responding NO	2.9	3.3

Of the 34 students enrolled at the ITV host site, 33 responded yes to taking another ITV class in the future. Of the 30 students enrolled at the ITV remote site in Kingsport, 29 responded yes to taking another ITV class in the future. Thus, in answer to the question "Would you take another class taught via interactive television?" ITV host site students' responses were: Yes - 97.1% and No - 2.9%. ITV remote site students' responses were: Yes - 96.7% and No - 3.3%. Therefore, there were no significant differences in Intermediate Algebra student attitudes toward enrolling in future ITV courses when comparing the host site with the remote site.

Table 14

Intermediate Algebra Student Responses Toward Taking Another  
ITV Math Class

	ITV Host Site	ITV Remote Site
Students responding YES	33	29
Students responding NO	1	1
Percentage responding YES	97.1	96.7
Percentage responding NO	2.9	3.3

Of the 34 students enrolled at the ITV host site, 33 responded yes to taking another math ITV class. Of the 30 students enrolled at the ITV remote site in Kingsport, 29 responded yes to taking another math ITV class. Thus, in answer to the question "Would you take another math class taught via interactive television?" ITV host site students' responses were: Yes - 97.1% and No - 2.9%. ITV remote site students' responses were: Yes - 96.7% and No - 3.3%. Therefore, there were no significant differences in Intermediate Algebra student attitudes toward enrolling in future ITV math courses when comparing the host site with the remote site.

## CHAPTER 5

### Summary, Conclusions, and Recommendations for Further Study

#### Summary

A dramatic expansion of distance learning through the use of interactive television is allowing colleges and universities to offer students potentially unlimited access to educational and training opportunities. The U.S. Congress Office of Technology Assessment defines distance learning as the "linking of a teacher and students in several geographic locations via technology that allows for interaction" (1989, p. 4). Distance education occurs when there is a "physical separation of the teacher and learner and when communication and instruction take place through, or are supported by, technological means such as telephone, radio, television, computers, satellite delivery, interactive video, or any combination of present and future telecommunication technologies" (Tennessee Board of Regents, 1993, p. 1).

Descriptions of distance education tend to change radically, depending on which technology is being employed. Distance education today ranges from home correspondence courses to live, interactive television instruction. Live, interactive televised instruction includes provision for students and faculty to interact with one another in real

time (e.g., satellite, point-to-point microwave, cable T.V., etc.). Students also have immediate talk-back capability with the instructor (Commission on Colleges, 1993).

This type of distance education expands classrooms beyond the physical constraints of lecture halls and college campuses. Distance education gives students greater flexibility in scheduling and in locations of classes. Students who may have had difficulties attending classes at centralized, on-campus locations are now able to participate in those classes at locations removed from the centralized one (Britton, 1992). One of the prime advantages of an interactive television system is making university courses available to students who would not otherwise be able to pursue studies at this level. Many students work, have families, and are place-bound. Students find it a definite advantage to have classes in their home community (Fulmer et al., 1992).

While the expanding information age beckons us to consider mechanisms for using communication technologies for the benefit of meeting the needs of learners in a variety of locations, the question may be raised -- Is interactive television an effective medium of instruction? A review of the literature showed that there are conflicting opinions about the usefulness and effectiveness of interactive television in the classroom. None of the studies, however, focused on developmental algebra classes. This study

examined the effectiveness of using an interactive television system to broadcast Introductory and Intermediate Algebra classes at East Tennessee State University.

This study examined three groups of Introductory Algebra students and three groups of Intermediate Algebra students. In both courses, one group was taught algebra in an interactive television setting. This group of students was given instruction in a television studio equipped with cameras. There were also microphones at each student desk. The instructor was physically present with these students. Math instruction was given on camera, with the students seeing the problems worked by the instructor on two overhead television screens. Instruction originated in this on-campus studio (host site) and was transmitted to a group of students in Kingsport (remote site). These students in Kingsport comprised the second group in the study. They were part of this live, interactive instruction. They could talk to the instructor via cordless telephone at any time during the class. Students in Kingsport saw and heard everything as it happened in the on-campus studio. However, the students and the instructor at the on-campus site could only hear the students in Kingsport (two-way audio but only one-way video). The third group of students in the study was taught algebra in a traditional classroom setting. The teacher was present with these students and instruction was given utilizing the chalkboard.



This study focused on the achievement of these three groups of developmental algebra students. The purpose of the study was to determine if there were differences in math achievement of students taught in an ITV class setting with the instructor present (host site), students receiving instruction via television at an off-campus/remote location, and students taught in a traditional class setting. This study also compared traditional students and nontraditional students to see if there were differences in achievement based on age, as well as the instructional delivery method. Finally, this study tried to determine if students who enrolled in a developmental algebra course taught via interactive television would consider taking another ITV course in the future, and if they would consider taking another ITV math course in the future.

Any new method of instructional delivery requires assessment to determine the strengths and weaknesses of the system. Technology applied to education produces a greater need to evaluate outcomes to provide evidence that students in ITV classrooms will achieve as well as those students taught in traditional classrooms. If the system fails to achieve these goals, the method of delivery needs to be reconsidered.

The use of interactive television to offer courses at remote locations holds promise for being an exciting method of reaching more students than would generally be able to

attend if classes were restricted to lecture halls and classrooms on campus. If it can be shown that the students at the distance learning sites are learning as well as those students in the traditional classrooms, then there would be empirical evidence that ITV should be considered as an adequate method of providing instruction beyond the campus.

For the purposes of this study, the sample was made up of all developmental students at ETSU enrolled in an Introductory Algebra course or an Intermediate Algebra course taught via ITV during the following seven consecutive semesters: Spring 1993, Summer 1993, Fall 1993, Spring 1994, Summer 1994, Fall 1994, and Spring 1995. The researcher was the instructor for all of these classes. The sample also included developmental students at ETSU enrolled in an Introductory Algebra course or an Intermediate Algebra course taught in this instructor's traditional classrooms during these same semesters. Over the period of these seven semesters, 189 students were enrolled in the Introductory Algebra course under investigation, and 112 students were enrolled in the Intermediate Algebra course under investigation. Of the 189 Introductory Algebra students, 89 were traditional age (22 and younger) and 100 were nontraditional age (23 and older). Of the 112 Intermediate Algebra students, 42 were traditional age and 70 were nontraditional age.

### Conclusions

Eight null hypotheses were tested in this study. The hypotheses are addressed sequentially.

#### Null Hypotheses 1 and 2

$H_01$ : There will be no significant differences in student achievement in Introductory Algebra using three different methods of delivering instruction: host site (ITV with the teacher present), ITV at remote site, and traditional classroom.

$H_02$ : There will be no significant differences in student achievement in Introductory Algebra using three different methods of delivering instruction when comparing traditional students with nontraditional students.

Null hypotheses one and two were tested using a two-way analysis of variance with one covariate (ANCOVA). In the ANCOVA procedure the independent variable was the method of delivery to students at the three instructional sites (Group 1 - ITV host site, Group 2 - ITV remote site, and Group 3 - Traditional classroom). Student age was a classifying independent variable. Students were either traditional age (22 and younger) or nontraditional age (23 and older). The dependent variable used in the ANCOVA procedure was each student's final course grade. A covariate was used to control for any preexisting differences among the groups prior to the research. The covariate used in this study was

each student's proficiency test score. The results of the ANCOVA showed no significant differences among the three groups on the dependent variable (final course grade). Therefore, it was concluded that there were no significant differences in student achievement in Introductory Algebra using three different methods of delivering instruction.

The results of the ANCOVA also showed no significant differences among the three groups on the dependent variable (final course grade) when comparing traditional age students with nontraditional age students. Therefore, it was concluded that there were no significant differences in student achievement in Introductory Algebra using three different methods of delivering instruction when comparing traditional students with nontraditional students.

The ANCOVA procedure calculated adjusted means (adjusted for the covariate) for traditional and nontraditional students in each of the three groups. The traditional age students at the ITV remote site in Kingsport had the highest group mean for Introductory Algebra ( $\bar{m} = 87.652$ ), while the traditional age students in the traditional classroom setting had the lowest group mean for Introductory Algebra ( $\bar{m} = 82.328$ ).

#### Null Hypotheses 3 and 4

$H_{03}$ : There will be no significant differences in Introductory Algebra student attitudes toward enrolling in

future ITV courses when comparing the host site with the remote site.

$H_04$ : There will be no significant differences in Introductory Algebra student attitudes toward enrolling in future ITV math courses when comparing the host site with the remote site.

Students at both the ITV host site on campus and the ITV remote site in Kingsport overwhelmingly responded yes toward taking future ITV classes and future ITV math classes. In Introductory Algebra, 100% of the students at the host site responded yes to enrolling in future ITV courses with 97.6% of the students at the remote site responding yes. At the ITV host site, 100% of the students responded yes to enrolling in future ITV math courses with 95.1% of the students at the remote site responding yes. Therefore, it was concluded that there were no significant differences in Introductory Algebra student attitudes toward enrolling in future ITV courses when comparing the host site with the remote site. It was also concluded that there were no significant differences in Introductory Algebra student attitudes toward enrolling in future ITV math courses when comparing the host site with the remote site.

#### Null Hypotheses 5 and 6

$H_05$ : There will be no significant differences in student achievement in Intermediate Algebra using three

different methods of delivering instruction: host site (ITV with the teacher present), ITV at remote site, and traditional classroom.

H<sub>06</sub>: There will be no significant differences in student achievement in Intermediate Algebra using three different methods of delivering instruction when comparing traditional students with nontraditional students.

Null hypotheses five and six were tested using a two-way analysis of variance with one covariate (ANCOVA). In the ANCOVA procedure the independent variable was the method of delivery to students at the three instructional sites (Group 1 - ITV host site, Group 2 - ITV remote site, and Group 3 - Traditional classroom). Student age was a classifying independent variable. Students were either traditional age (22 and younger) or nontraditional age (23 and older). The dependent variable used in the ANCOVA procedure was each student's final course grade. A covariate was used to control for any preexisting differences among the groups prior to the research. The covariate used in this study was each student's proficiency test score. The results of the ANCOVA showed no significant differences among the three groups on the dependent variable (final course grade). Therefore, it was concluded that there were no significant differences in student achievement in Intermediate Algebra using three different methods of delivering instruction.

The results of the ANCOVA also showed no significant differences among the three groups on the dependent variable (final course grade) when comparing traditional age students with nontraditional age students. Therefore, it was concluded that there were no significant differences in student achievement in Intermediate Algebra using three different methods of delivering instruction when comparing traditional students with nontraditional students.

The ANCOVA procedure calculated adjusted means (adjusted for the covariate) for traditional and nontraditional students in each of the three groups. The nontraditional age students at the ITV remote site in Kingsport had the highest group mean for Intermediate Algebra ( $\bar{m} = 92.011$ ), while the traditional age students in the traditional classroom setting had the lowest group mean for Intermediate Algebra ( $\bar{m} = 82.725$ ).

#### Null Hypotheses 7 and 8

H<sub>0</sub>7: There will be no significant differences in Intermediate Algebra student attitudes toward enrolling in future ITV courses when comparing the host site with the remote site.

H<sub>0</sub>8: There will be no significant differences in Intermediate Algebra student attitudes toward enrolling in future ITV math courses when comparing the host site with the remote site.

Students at both the ITV host site on campus and the ITV remote site in Kingsport overwhelmingly responded yes toward taking future ITV classes and future ITV math classes. In Intermediate Algebra, 97.1% of the students at the host site responded yes to enrolling in future ITV courses with 96.7% of the students at the remote site responding yes. At the ITV host site, 97.1% of the students responded yes to enrolling in future ITV math courses with 96.7% of the students at the remote responding yes. Therefore, it was concluded that there were no significant differences in Intermediate Algebra student attitudes toward enrolling in future ITV courses when comparing the host site with the remote site. It was also concluded that there were no significant differences in Intermediate Algebra student attitudes toward enrolling in future ITV math courses when comparing the host site with the remote site.

The conclusions that can be drawn based on the results of this study are:

1. Students at the distant learning site in Kingsport performed as well as the students in the traditional classroom in both Introductory and Intermediate Algebra courses.
2. Students in both Introductory Algebra and Intermediate Algebra had positive attitudes toward future participation in interactive television courses.



3. The results of this study give empirical evidence that ITV should be considered as an adequate method of providing instruction (at least in developmental algebra) beyond the campus.

#### Recommendations for Further Study

In order to determine the applicability and validity of distance learning through ITV, additional research is required. From this study emerge additional questions.

Questions that could be posed in future studies include:

1. To what extent do corresponding studies of other ITV systems find similar or disparate results?
2. How does the role of interaction between distant students and the instructor relate to student achievement?
3. How does class size effect student achievement and satisfaction in ITV courses?
4. How does the climate or culture within ITV classrooms impact course success?
5. What are the cost benefits of the various distance education media as these relate to institutional budgeting?
6. What are the skills required for effective distant teaching?
7. Are distant teaching skills different from the skills required by the traditional on-campus instructor?

8. What institutional policies support or hinder distance teaching?

These are but a few of the questions which warrant future investigation.

## REFERENCES

-

- Aggasiz, E. C. (1971). Society to encourage studies at home. In O. MacKenzie (Ed.), The changing world of correspondence study. University Park: Pennsylvania State University Press.
- Beare, P. L. (1989). The comparative effectiveness of videotape, audiotape, and telelecture in delivering continuing teacher education. The American Journal of Distance Education, 3(2), 23-32.
- Bink, M. L., Biner, P. M., Huffman, M. L., Geer, B. L., & Dean, R. S. (1995). Attitudinal, college/course-related, and demographic predictors of performance in televised continuing education courses. The Journal of Continuing Higher Education, 43(2), 14-20.
- Bloom, R. (1984). Teaching on television: An instructional alternative. Business Education Forum, 38(6), 5-6.
- Borg, W. R., & Gall, M. D. (1989). Educational research: An introduction (5th ed.). New York: Longman.
- Britton, O. L. (1992). Interactive distance education in higher education and the impact of delivery styles on student perceptions (Doctoral dissertation, Wayne State University, 1992). Dissertation Abstracts International, 53, 4223A.
- Brown, E. E. (1988). The live video teleconference in distance learning. Lifelong Learning: An Omnibus of Practice and Research, 11(5), 8-10.

- Burke, M. A. (1991). Telecommunications consortium provides long-distance education. NASSP Bulletin, 75(538), 129-130.
- Cartwright, G. P. (1994). Distance learning: A different time, a different place. Change, 26(4), 30-32.
- Center for Adult Programs & Services. (1995). Returning to school? We can help [Brochure]. Johnson City, TN: East Tennessee State University Press.
- Clark, R. E. (1983). Reconsidering research on learning from media. Review of Educational Research, 53(4), 445-449.
- Commission on Colleges, Southern Association of Colleges and Schools (SACS). Definitions, Location Codes and Descriptions of Technical Terms used for Distance Learning and Report Forms. (1993, June).
- DeLoughry, T. J. (1994, October 19). Pushing the envelope. The Chronicle of Higher Education, pp. A36, A38.
- Dillon, C. L., Gunawardena, C. N., & Parker, R. (1992). Learner support in distance education: An evaluation of a state-wide telecommunications system. International Journal of Instructional Media, 19(4), 297-311.
- Dinsdale, W. A. (1953) Inception and development of postal tuition. The Statist, 21, 572-575.
- Egan, M. W., Welch, M., Page, B., & Sebastian, J. (1992). Learners' perceptions of instructional delivery

- systems: Conventional and television. The American Journal of Distance Education, 6(2), 47-55.
- East Tennessee State University Fact Book. (1994). Johnson City, TN: East Tennessee State University Press.
- East Tennessee State University Undergraduate Catalog. (1994-1995). Johnson City, TN: East Tennessee State University Press.
- Fulmer, J., Hazzard, M., Jones, S., & Keene, K. (1992). Distance learning: An innovative approach to nursing education. Journal of Professional Nursing, 8(5), 289-294.
- Gay, L. R. (1992). Educational research: Competencies for analysis and application (4th ed.). New York: Merrill.
- Graham, E. (1991, September 13). On-line teaching: 'Distance education' uses electronic links to recast the campus. The Wall Street Journal, pp. A1, A5.
- Gunawardena, C. N. (1992). Changing faculty roles for audiographics and online teaching. The American Journal of Distance Education, 6(3), 58-71.
- Hackman, M. Z., & Walker, K. B. (1990). Instructional communication in the televised classroom: The effects of system design and teacher immediacy on student learning and satisfaction. Communication Education, 39(3), 196-206.

- Hersey, P., & Blanchard, K. H. (1974). So you want to know your leadership style? Training and Development, 28(2), 22-27.
- Hinkle, D. E., Wiersma, W., & Jurs, S. G. (1988). Applied statistics for the behavioral sciences (2nd ed.). Boston: Houghton Mifflin.
- Holmberg, B. (1989). Theory and practice of distance education. New York: Routledge.
- Jacobson, R. L. (1994, July 6). Extending the reach of 'virtual' classrooms. The Chronicle of Higher Education, pp. A19-A21, A23.
- Kendall, J. R., & Oaks, M. (1992). Evaluation of perceived teaching effectiveness: Course delivery via interactive video technology versus traditional classroom methods. The Journal of Continuing Higher Education, 40(3), 2-12.
- Koenig, A. E., & Hill, R. B. (1967). The farther vision: Educational television today. Madison, WI: University of Wisconsin Press.
- Koontz, F. R. (1989). Critical barriers to the adoption of instructional television in higher education. Educational Technology, 29(4), 45-48.
- Kromholz, S. F., & Johnstone, S. M. (1988). A practical application to training instructional television faculty and students. Lifelong Learning: An Omnibus of Practice and Research, 11(8), 15-16.

- Lial, M., Miller, C., & Hornsby, E. (1992). Intermediate Algebra (6th ed.). New York: HarperCollins.
- Ludlow, N. (1987). Interview with Michael Lambert. The American Journal of Distance Education, 1(2), 67-71.
- Magiera, F. T. (1994). Teaching managerial finance through compressed video: An alternative for distance education. Journal of Education for Business, 69(5), 273-277.
- Maher, J. H., Jr. (1984, January). The interactive instructional television program: University courses for industry employees: Rational and planning. Paper presented at the meeting of the Association for Educational Communications and Technology, Dallas, TX.
- Martin, E. D., & Rainey, L. (1993). Student achievement and attitude in a satellite-delivered high school science course. The American Journal of Distance Education, 7(1), 54-61.
- McCleary, I. D., & Egan, M. W. (1989). Program design and evaluation: Two-way interactive television. The American Journal of Distance Education, 3(1), 50-60.
- McKell, L. J., Hardy, J. W., & Stocks, K. D. (1992, November). The IBM CENET system: Continuing education for management. T.H.E. Journal, 93-97.
- McLarin, K. J. (1990, February 22). Learning from afar: Connecting teachers and students via high technology. The Washington Post, p. 11.



- McMurray, J., & Trott, J. (1987, October). Telelearning offers new alternatives for T&I delivery systems. Paper presented at the conference of the American Vocational Association, Las Vegas, NV.
- Mehrabian, A. (1969). Some referents and measures of nonverbal behavior. Behavioral Research Methods and Instruments, 1, 213-217.
- Moore, M. G. (1987). University distance education of adults. TechTrends, 32(4), 13-18.
- Moore, M. G. (1989a). Distance education: A learner's system. Lifelong Learning, 12(8), 8-11.
- Moore, M. G. (1989b). Recruiting and retaining adult students in distance education. In P. S. Cookson (Ed.), Recruiting and retaining adult students. San Francisco: Jossey-Bass.
- Nelson, R. N. (1989). Two-way microwave transmission consolidates, improves education. NASSP Bulletin, 73(520), 38-42.
- Pirrong, G. D., & Lathen, W. C. (1990). The use of interactive television in business education. Educational Technology, 30(5), 49-54.
- Porter, K. W. (1990, April). Tuning in to tv training. Training & Development Journal, 9, 73-77.
- Ritchie, H., & Newby, T. J. (1989). Classroom lecture/discussion vs. live televised instruction: A comparison of effects on student performance, attitude

- and interaction. The American Journal of Distance Education, 3(3), 36-45.
- Robinson, R. S., & West, P. C. (1986, April). Interactive cable television: An evaluation study. Paper presented at the annual conference of the American Educational Research Association, San Francisco, CA.
- Rudestam, K. E., & Newton, R. R. (1992). Surviving your dissertation: A comprehensive guide to content and process. Newbury Park, CA: Sage.
- Russell, T. L. (1992). Which television medium is best for distance learning: The rationale behind the videoclass system. ED Journal, 7(8), J1-J6.
- Schatz, L. (1993). ICN results from statewide cooperation. Quarterly Exchange, 4(1), 2.
- Schmidt, B. J., & Faulkner, S. L. (1989). Staff development through distance education. Journal of Staff Development, 10(4).
- Short, J., Williams, E., & Christie, B. (1976). The social psychology of telecommunications. New York: Wiley.
- Simonson, M. R., Schlosser, C., & Anderson, M. (Eds.). (1995). Encyclopedia of distance education research in Iowa. Unpublished manuscript, Iowa State University at Ames.
- Simpson, H., Pugh, H. L., & Parchman, S. W. (1993). Empirical comparison of alternative instructional TV technologies. Distance Education, 14(1), 147-164.

- Souder, W. E. (1993). The effectiveness of traditional vs. satellite delivery in three management of technology master's degree programs. The American Journal of Distance Education, 7(1), 37-53.
- Strain, J. (1987). The role of the faculty member in distance education. The American Journal of Distance Education, 1(2), 51-55.
- Sukow, R. (1992, November 30). Government or business: The developing battle over who takes the lead in distance learning. Broadcasting, 42, 46, 47.
- TBR AAPP student information bulletin. (1994). [brochure]. Nashville, TN: Tennessee Collaborative for Educational Excellence.
- Tennessee Board of Regents, Policy from the Distance Education Committee. Policy No. 2:05:00:00 (1993).
- Timpson, W., & Jones, C. (1989). Distance learning via technology. The Gifted Child Today, 12, 10-11.
- U.S. Congress, Office of Technology Assessment. (1989). Linking for learning: A new course for education (OTA-SET-430). Washington, DC: U.S. Government Printing Office.
- Verduin, J. R., Jr., & Clark, T. A. (1991). Distance education: The foundations of effective practice. San Francisco, CA: Jossey-Bass.
- Walker, K., Hackman, M., & Eames, C. (1989, November). Developing, instruction and evaluating televised

education programs: Suggestions for communication educators. Paper presented at the annual meeting of the Speech Communication Association, San Francisco, CA.

Wedemeyer, C. A. (1983). Learning at the back door.

Madison, WI: University of Wisconsin Press.

Whittington, N. (1987). Is instructional television educationally effective? A research review. The American Journal of Distance Education, 1(1), 47-57.

Wilkes, C. W., & Burnham, B. R. (1991). Adult learner motivations and electronic distance education. The American Journal of Distance Education, 5(1), 43-50.

Wolcott, L. L. (1993). Faculty planning for distance teaching. The American Journal of Distance Education, 7(1), 26-35.

## **APPENDIX A**

## ITV HOST SITE SYLLABUS - Introductory Algebra

CLASS: DVMA-0810-095 Introductory Algebra 9:05-10:00 W 123

TEXTBOOK: Intermediate Algebra by Lial/Miller/Hornsby

INSTRUCTOR: Ms. Sherri Hodge-Hardin

OFFICE: 119 Rogers-Stout

PHONE: 929-6354

Grades for this class will be determined as follows:

4 tests @ 20% each

1 final @ 20% (This is a Comprehensive Exam)

If an exam is missed, there will be NO make-up exam!!!

Grading Scale: 90 - 100 A  
87 - 89 A-  
84 - 86 B+  
80 - 83 B  
77 - 79 B-  
74 - 76 C+  
70 - 73 C  
Below 70 F

Should you need to see me about any problems or questions concerning this class, I will be available in room 119 Rogers-Stout at the following times:

Mondays and Wednesdays: 11:00 - 2:00

Tuesdays and Thursdays: 9:30 - 11:00 and 2:00 - 4:00

ATTENDANCE POLICY: After 5 absences I will drop your grade 1 letter. Coming to class late (after roll has been called) or leaving class early constitutes an absence.

\*\*\*\*\*FREE MATH TUTORING in the Developmental Studies Learning Center located in Rooms 307-308 of Warf-Pickel Hall. Also in the Learning center are computer tutorials that go along with your textbook. Take advantage of this!!

Every class period is videotaped. If you miss a class (and want to view what you missed), a copy of each class will be available for viewing at the Instructional Media Center, room 209 Warf-Pickel Hall, or at the Kingsport University Center library. The tapes will be available at these location usually within a day after broadcast and will be on reserve for 2 weeks after broadcast. At that time the tapes are erased for reuse. These tapes cannot be checked out. They must be watched at their location.

## ITV REMOTE SITE SYLLABUS - Introductory Algebra

CLASS: DVMA-0810-513 Introductory Algebra 9:05-10:00 KPT

TEXTBOOK: Intermediate Algebra by Lial/Miller/Hornsby

INSTRUCTOR: Ms. Sherri Hodge-Hardin

FACILITATOR:

OFFICE: 119 Rogers-Stout

Richard Lequieu

PHONE: 929-6354

Grades for this class will be determined as follows:

4 tests @ 20% each

1 final @ 20% (This is a Comprehensive Exam)

If an exam is missed, there will be NO make-up exam!!!

Grading Scale: 90 - 100 A  
87 - 89 A-  
84 - 86 B+  
80 - 83 B  
77 - 79 B-  
74 - 76 C+  
70 - 73 C  
Below 70 F

Should you need to see me about any problems or questions concerning this class, I will be available in room 119 Rogers-Stout at the following times:

Mondays and Wednesdays: 11:00 - 2:00

Tuesdays and Thursdays: 9:30 - 11:00 and 2:00 - 4:00

ATTENDANCE POLICY: After 5 absences I will drop your grade 1 letter. Coming to class late (after roll has been called) or leaving class early constitutes an absence.

\*\*\*\*\*FREE MATH TUTORING in the Developmental Studies Learning Center located in Rooms 307-308 of Warf-Pickel Hall. Also in the Learning center are computer tutorials that go along with your textbook. Take advantage of this!!

Every class period is videotaped. If you miss a class (and want to view what you missed), a copy of each class will be available for viewing at the Instructional Media Center, room 209 Warf-Pickel Hall, or at the Kingsport University Center library. The tapes will be available at these location usually within a day after broadcast and will be on reserve for 2 weeks after broadcast. At that time the tapes are erased for reuse. These tapes cannot be checked out. They must be watched at their location.

**TRADITIONAL CLASSROOM SYLLABUS - Introductory Algebra**

CLASS: DVMA-0810-005 Introductory Algebra 8:00-8:55 W 228  
TEXTBOOK: Intermediate Algebra by Lial/Miller/Hornsby

INSTRUCTOR: Ms. Sherri Hodge-Hardin  
OFFICE: 119 Rogers-Stout  
PHONE: 929-6354

Grades for this class will be determined as follows:

4 tests @ 20% each  
1 final @ 20% (This is a Comprehensive Exam)

If an exam is missed, there will be NO make-up exam!!!

Grading Scale: 90 - 100 A  
87 - 89 A-  
84 - 86 B+  
80 - 83 B  
77 - 79 B-  
74 - 76 C+  
70 - 73 C  
Below 70 F

Should you need to see me about any problems or questions concerning this class, I will be available in room 119 Rogers-Stout at the following times:

Mondays and Wednesdays: 11:00 - 2:00  
Tuesdays and Thursdays: 9:30 - 11:00 and 2:00 - 4:00

ATTENDANCE POLICY: After 5 absences I will drop your grade 1 letter. Coming to class late (after roll has been called) or leaving class early constitutes an absence.

\*\*\*\*\*FREE MATH TUTORING in the Developmental Studies Learning Center located in Rooms 307-308 of Warf-Pickel Hall. Also in the Learning center are computer tutorials that go along with your textbook. Take advantage of this!!



## ITV HOST SITE SYLLABUS - Intermediate Algebra

CLASS: DVMA-0820-095 Intermediate Algebra 9:05-10:00 W 123

TEXTBOOK: Intermediate Algebra by Lial/Miller/Hornsby

INSTRUCTOR: Ms. Sherri Hodge-Hardin

OFFICE: 119 Rogers-Stout

PHONE: 929-6354

Grades for this class will be determined as follows:

4 tests @ 20% each

1 final @ 20% (This is a Comprehensive Exam)

If an exam is missed, there will be NO make-up exam!!!

Grading Scale: 90 - 100 A  
87 - 89 A-  
84 - 86 B+  
80 - 83 B  
77 - 79 B-  
74 - 76 C+  
70 - 73 C  
Below 70 F

Should you need to see me about any problems or questions concerning this class, I will be available in room 119 Rogers-Stout at the following times:

Mondays and Wednesdays: 11:00 - 2:00

Tuesdays and Thursdays: 9:30 - 11:00 and 2:00 - 4:00

ATTENDANCE POLICY: After 5 absences I will drop your grade 1 letter. Coming to class late (after roll has been called) or leaving class early constitutes an absence.

\*\*\*\*\*FREE MATH TUTORING in the Developmental Studies Learning Center located in Rooms 307-308 of Warf-Pickel Hall. Also in the Learning center are computer tutorials that go along with your textbook. Take advantage of this!!

Every class period is videotaped. If you miss a class (and want to view what you missed), a copy of each class will be available for viewing at the Instructional Media Center, room 209 Warf-Pickel Hall, or at the Kingsport University Center library. The tapes will be available at these location usually within a day after broadcast and will be on reserve for 2 weeks after broadcast. At that time the tapes are erased for reuse. These tapes cannot be checked out. They must be watched at their location.

# ITV REMOTE SITE SYLLABUS - Intermediate Algebra

CLASS: DVMA-0820-513 Intermediate Algebra 9:05-10:00 KPT

TEXTBOOK: Intermediate Algebra by Lial/Miller/Hornsby

INSTRUCTOR: Ms. Sherri Hodge-Hardin

FACILITATOR:

OFFICE: 119 Rogers-Stout

Richard Lequieu

PHONE: 929-6354

Grades for this class will be determined as follows:

4 tests @ 20% each

1 final @ 20% (This is a Comprehensive Exam)

If an exam is missed, there will be NO make-up exam!!!

Grading Scale: 90 - 100 A  
87 - 89 A-  
84 - 86 B+  
80 - 83 B  
77 - 79 B-  
74 - 76 C+  
70 - 73 C  
Below 70 F

Should you need to see me about any problems or questions concerning this class, I will be available in room 119 Rogers-Stout at the following times:

Mondays and Wednesdays: 11:00 - 2:00

Tuesdays and Thursdays: 9:30 - 11:00 and 2:00 - 4:00

ATTENDANCE POLICY: After 5 absences I will drop your grade 1 letter. Coming to class late (after roll has been called) or leaving class early constitutes an absence.

\*\*\*\*\*FREE MATH TUTORING in the Developmental Studies Learning Center located in Rooms 307-308 of Warf-Pickel Hall. Also in the Learning center are computer tutorials that go along with your textbook. Take advantage of this!!

Every class period is videotaped. If you miss a class (and want to view what you missed), a copy of each class will be available for viewing at the Instructional Media Center, room 209 Warf-Pickel Hall, or at the Kingsport University Center library. The tapes will be available at these location usually within a day after broadcast and will be on reserve for 2 weeks after broadcast. At that time the tapes are erased for reuse. These tapes cannot be checked out. They must be watched at their location.

**TRADITIONAL CLASSROOM SYLLABUS - Intermediate Algebra**

CLASS: DVMA-0820-012 Intermediate Algebra 10:10-11:05 N 121

TEXTBOOK: Intermediate Algebra by Lial/Miller/Hornsby

INSTRUCTOR: Ms. Sherri Hodge-Hardin

OFFICE: 119 Rogers-Stout

PHONE: 929-6354

Grades for this class will be determined as follows:

4 tests @ 20% each

1 final @ 20% (This is a Comprehensive Exam)

If an exam is missed, there will be NO make-up exam!!!

Grading Scale: 90 - 100 A  
87 - 89 A-  
84 - 86 B+  
80 - 83 B  
77 - 79 B-  
74 - 76 C+  
70 - 73 C  
Below 70 F

Should you need to see me about any problems or questions concerning this class, I will be available in room 119 Rogers-Stout at the following times:

Mondays and Wednesdays: 11:00 - 2:00

Tuesdays and Thursdays: 9:30 - 11:00 and 2:00 - 4:00

ATTENDANCE POLICY: After 5 absences I will drop your grade 1 letter. Coming to class late (after roll has been called) or leaving class early constitutes an absence.

\*\*\*\*\*FREE MATH TUTORING in the Developmental Studies Learning Center located in Rooms 307-308 of Warf-Pickel Hall. Also in the Learning center are computer tutorials that go along with your textbook. Take advantage of this!!

## APPENDIX B

SHOW ALL WORK.

Find the value of the expression.

1.  $24 + 23 \cdot 3 - (-27)$

A. 120

B. 42

C. 168

D. 77

Perform the indicated operation.

2.  $-\frac{11}{4} \div (-11)$

A.  $-\frac{121}{4}$ B.  $-\frac{1}{4}$ C.  $\frac{121}{4}$ D.  $\frac{1}{4}$ 

3.  $(-13) + 12 + (-24)$

A. 23

B. 25

C. 49

D. -25

4.  $|-3| + 5^2 - (-4^2)$

A. 12

B. 38

C. 24

D. 44

Simplify the expression.

5.  $12(x - 10) - 10[11y - (10x - y)]$

A.  $-88x - 100y - 120$ C.  $112x - 130y - 120$ B.  $112x - 100y - 120$ D.  $112x - 120y - 120$ 

Solve the equation.

6.  $7x - (2x - 1) = 2$

A.  $\{-\frac{1}{5}\}$ B.  $\{\frac{1}{5}\}$ C.  $\{-\frac{1}{9}\}$ D.  $\{\frac{1}{9}\}$ 

7.  $\frac{1}{3}(6x - 12) = \frac{1}{2}(8x - 4)$

A.  $\{-\frac{1}{8}\}$ B.  $\{-8\}$ C.  $\{-1\}$ D.  $\{1\}$ 

8.  $17t - 1 = 2t + 11$

A.  $\{\frac{4}{5}\}$ B.  $\{\frac{17}{10}\}$ C.  $\{-\frac{4}{5}\}$ D.  $\{\frac{19}{4}\}$ 

Solve the formula for the specified variable.

9.  $A = P(1 + nr)$  for  $r$

A.  $\frac{Pn}{A - P}$ B.  $\frac{A - P}{Pn}$ C.  $\frac{A}{n}$ D.  $\frac{P - A}{Pn}$ 

Solve the problem.

10. One half of a number is 3 more than one-sixth the same number. What is the number?

A. 8

B. 18

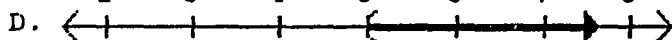
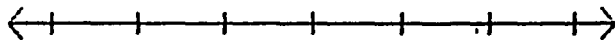
C. 12

D. 9

Solve the inequality, then graph the solution.

114

11.  $-35 > -7c$



Solve the equation.

12.  $|b - 7| - 9 = -7$

A.  $\{-9, -5\}$  B.  $\{9\}$

C.  $\{9, 5\}$

D.  $\emptyset$

Evaluate the expression.

13.  $(-8)^0 + (-15)^0$

A. 2

B. -2

C. -23

D. 0

Write the expression without exponents.

14.  $-9^{-4}$

A. 6,561

B. 36

C.  $-\frac{1}{6,561}$

D.  $-\frac{1}{36}$

Simplify using only positive exponents. Assume that variables represent nonzero real numbers.

15.  $\frac{2^{-3}(r^{-2})^{-1}}{2^9(r^2)^{-3}}$

A.  $\frac{1}{2^9 r^2}$

B.  $\frac{r^8}{2^{-12}}$

C.  $\frac{r^6}{2^6}$

D.  $\frac{r^8}{2^{12}}$

Express the number in scientific notation.

16. 0.000698

A.  $6.98 \times 10^{-3}$

C.  $6.98 \times 10^{-4}$

B.  $6.98 \times 10^{-5}$

D.  $6.98 \times 10^4$

Perform the indicated operation.

17.  $(5n^6 - 10n^3 - 14) - (8n^3 + 8n^6 - 10)$

A.  $-3n^6 - 2n^3 - 24$

C.  $-25n^9$

B.  $-3n^6 - 18n^3 - 4$

D.  $-3n^6 - 18n^3 - 24$

Find the product.

115

18.  $(x + 4)(x - 11)$

A.  $x^2 - 7x - 44$

B.  $x^2 - 8x - 44$

C.  $x^2 - 7x - 8$

D.  $x^2 - 44x - 7$

19.  $-4x^5(-6x - 4)$

A.  $-24x^6 - 16x^5$

B.  $24x^5 + 16$

C.  $40x^6$

D.  $24x^6 + 16x^5$

Factor as completely as possible.

20.  $x^2 - 10xy + 25y^2$

A.  $(x - 5y)^2$

B.  $(x + 5y)^2$

C.  $(x - 5y)(x + 5y)$

D.  $(x + 1)(x + 25)$

21.  $4x^2 - 81$

A.  $(4x + 1)(x - 81)$

B.  $(2x - 9)^2$

C.  $(2x + 9)(2x - 9)$

D.  $(2x + 9)^2$

Solve the equation.

22.  $4k^2 - 19k - 5 = 0$

A.  $-\frac{1}{4}, 5$

B.  $-\frac{1}{4}, 4$

C.  $\frac{1}{19}, -\frac{1}{4}$

D.  $-4, 5$

Express the rational expression in lowest terms.

23.  $\frac{2x + 4}{10x^2 + 24x + 8}$

A.  $\frac{2x}{5x + 2}$

B.  $\frac{2x + 5}{5x + 24}$

C.  $\frac{1}{5x + 2}$

D.  $\frac{2x + 4}{10x^2 + 24x + 8}$

Perform the indicated operation and simplify.

24.  $\frac{5p - 5}{p} \cdot \frac{6p^2}{9p - 9}$

A.  $\frac{10p}{3}$

B.  $\frac{30p^3 - 30p^2}{9p^2 - 9p}$

C.  $\frac{45p^2 + 90p + 45}{6p^3}$

D.  $\frac{3}{10p}$

$$25. \quad \frac{4}{y^2 - 3y + 2} + \frac{7}{y^2 - 1}$$

116

$$A. \quad \frac{11y - 10}{(y - 1)(y - 2)}$$

$$B. \quad \frac{10y - 11}{(y - 1)(y + 1)(y - 2)}$$

$$C. \quad \frac{11y - 10}{(y - 1)(y + 1)(y - 2)}$$

$$D. \quad \frac{56y - 10}{(y - 1)(y + 1)(y - 2)}$$



- [ 1.3 ] 1) A
- [ 1.3 ] 2) D
- [ 1.3 ] 3) D
- [ 1.3 ] 4) D
- [ 1.4 ] 5) D
- [ 2.1 ] 6) B
- [ 2.1 ] 7) C
- [ 2.1 ] 8) A
- [ 2.2 ] 9) B
- [ 2.3 ] 10) D
- [ 2.5 ] 11) D
- [ 2.7 ] 12) C
- [ 3.1 ] 13) A
- [ 3.1 ] 14) C
- [ 3.2 ] 15) D
- [ 3.2 ] 16) C
- [ 3.3 ] 17) B
- [ 3.4 ] 18) A
- [ 3.4 ] 19) D
- [ 3.7 ] 20) A
- [ 3.7 ] 21) C
- [ 3.9 ] 22) A
- [ 4.1 ] 23) C
- [ 4.2 ] 24) A
- [ 4.3 ] 25) C

0810 - Please check yes or no to the following questions.

1. Would you take another math class taught via interactive television?

Yes \_\_\_\_\_ No \_\_\_\_\_

2. Would you take any other class taught via interactive television?

Yes \_\_\_\_\_ No \_\_\_\_\_

SHOW ALL WORK ON SEPARATE PAPER.

Perform the indicated operation and simplify.

1.  $\frac{-2x^2}{4} \div \frac{x^3}{28}$

A.  $\frac{x^5}{56}$

B.  $\frac{x}{14}$

C.  $\frac{14}{x}$

D.  $\frac{14x^2}{x^3}$

2.  $\frac{k^2 + 6k + 9}{k^2 + 10k + 21} \cdot \frac{k^2 + 7k}{k^2 + 10k + 21}$

A.  $\frac{k}{k + 7}$

C.  $\frac{k}{k^2 + 10k + 21}$

B.  $\frac{1}{k + 7}$

D.  $\frac{k^2 + 7k}{k + 7}$

3.  $\frac{2}{15x} + \frac{4}{21x^2}$

A.  $\frac{6}{315x^2}$

B.  $\frac{48}{105x^2}$

C.  $\frac{2(7x + 10)}{105x^2}$

D.  $\frac{6}{15x + 21x^2}$

4.  $\frac{3}{y^2 - 3y + 2} + \frac{7}{y^2 - 1}$

A.  $\frac{11y - 10}{(y - 1)(y + 1)(y - 2)}$

C.  $\frac{10y - 11}{(y - 1)(y - 2)}$

B.  $\frac{42y - 11}{(y - 1)(y + 1)(y - 2)}$

D.  $\frac{10y - 11}{(y - 1)(y + 1)(y - 2)}$

Simplify the complex fraction.

5.  $\frac{\frac{x}{9}}{\frac{2}{x + 9}}$

A.  $\frac{x + 9}{18x}$

B.  $18x(x + 9)$

C.  $\frac{2x}{9(x + 9)}$

D.  $\frac{x(x + 9)}{18}$

Perform the indicated operation.

6.  $\frac{-6x^3 - 5x^2 + 15x + 12}{3x - 2}$

A.  $-2x^2 - 3x + 3 + \frac{21}{3x - 2}$

C.  $-2x^2 - 3x + 3$

B.  $-2x^2 - 3x + 3 + \frac{18}{3x - 2}$

D.  $x^2 + 3 - \frac{3}{3x - 2}$

$$7. \frac{-16x^4 - 10x^3 - 14x^2}{-2x^3}$$

$$A. 8x - 10x^3 + \frac{7}{x}$$

$$C. 8x + 5 + \frac{7}{x}$$

$$B. 15x + 5$$

$$D. 8x + 5$$

Solve the equation.

$$8. \frac{7}{m-2} - \frac{5}{m+2} = \frac{10}{m^2-4}$$

$$A. \{\sqrt{29}\}$$

$$B. \{-7\}$$

$$C. \{-14\}$$

$$D. \{7\}$$

Simplify by writing the expression so that each variable occurs only once and all exponents are positive. Variables are positive real numbers.

$$9. \frac{y^{7/8}}{y^{3/8}}$$

$$A. \frac{1}{y}$$

$$B. y^{1/2}$$

$$C. y^{7/8}$$

$$D. y$$

$$10. x^{1/6} x^{5/6}$$

$$A. x^{5/6}$$

$$B. \frac{1}{x}$$

$$C. x$$

$$D. x^{5/36}$$

Simplify. Assume that all variables represent positive real numbers.

$$11. \sqrt{125k^7q^8}$$

$$A. (5k^3q^4)\sqrt{5}$$

$$C. (5q^4)\sqrt{5k^7}$$

$$B. (5k^7q^8)\sqrt{5k}$$

$$D. (5k^3q^4)\sqrt{5k}$$

$$12. \sqrt{80x^2y}$$

$$A. 4xy^2\sqrt{5}$$

$$B. 4x^2\sqrt{5y}$$

$$C. 4xy\sqrt{5}$$

$$D. 4x\sqrt{5y}$$

Perform the indicated operations and simplify. Assume all variables represent positive real numbers.

$$13. 5\sqrt{50} + 10\sqrt{200} - 8\sqrt{18}$$

$$A. 5\sqrt{2}$$

$$B. 101\sqrt{2}$$

$$C. -11\sqrt{2}$$

$$D. 11\sqrt{2}$$

Rationalize the denominator. Assume all variables represent positive real numbers.

121

14.  $-\sqrt{\frac{25}{28}}$

A.  $-5\sqrt{7}$

B.  $-28$

C.  $-\frac{5\sqrt{7}}{7}$

D.  $-\frac{5\sqrt{7}}{14}$

Perform the indicated operations and simplify.  
Assume all variables represent positive real numbers.

15.  $(\sqrt{5} - 6)(\sqrt{6} + 4)$

A.  $\sqrt{30} - 2\sqrt{6} - 24$

C.  $\sqrt{30} + 4\sqrt{5} - 6\sqrt{6} - 24$

B.  $\sqrt{30} - 24$

D.  $-1\sqrt{30} - 24$

Solve the equation.

16.  $\sqrt{p^2 - 5p + 16} = p - 1$

A.  $\{-\frac{5}{2}\}$

B.  $\{5\}$

C.  $\{4\}$

D.  $\{-5\}$

Use the quadratic formula to find the real number solutions.

17.  $6x^2 + 6x = -1$

A.  $\{\frac{-3 + \sqrt{3}}{6}, \frac{-3 - \sqrt{3}}{6}\}$

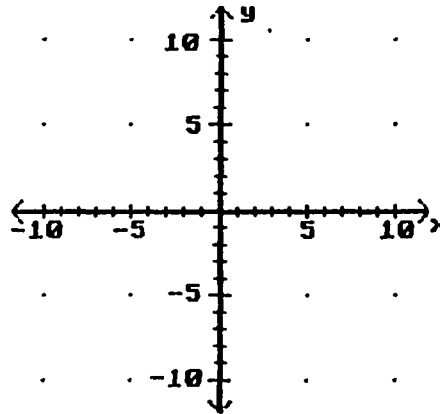
C.  $\{\frac{-3 + \sqrt{15}}{6}, \frac{-3 - \sqrt{15}}{6}\}$

B.  $\{\frac{-3 + \sqrt{3}}{12}, \frac{-3 - \sqrt{3}}{12}\}$

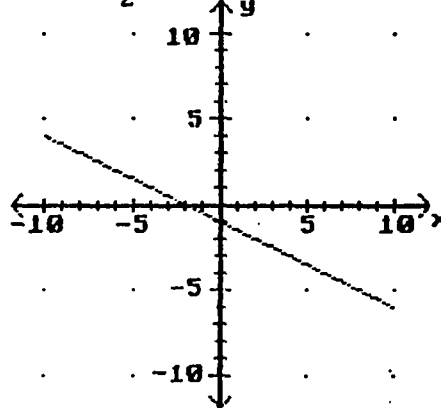
D.  $\{\frac{-6 + \sqrt{3}}{6}, \frac{-6 - \sqrt{3}}{6}\}$

Find the x- and y-intercepts for the equation. Then graph the equation.

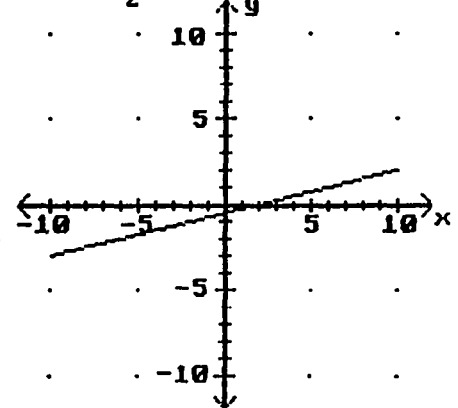
18.  $12y - 3x = -6$



A.  $(0, -\frac{1}{2}), (-2, 0)$



B.  $(0, -\frac{1}{2}), (2, 0)$



Find the slope of the line going through the pair of points.

19.  $(-2, 4)$  and  $(3, -1)$

A.  $-1$

B.  $-3$

C.  $3$

D.  $-\frac{3}{2}$

Give the standard form of the equation of the line satisfying the given conditions.

20. Through  $(2, 5)$ ,  $m = -\frac{8}{3}$

A.  $8x + 3y = 31$

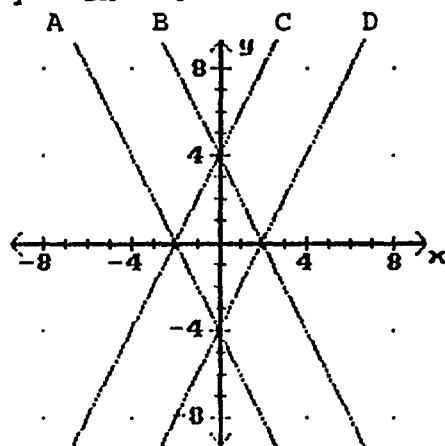
B.  $-8x + 3y = -1$

C.  $3x - 8y = -34$

D.  $8x + 3y = -31$

Choose one of the four lines graphed which most closely resembles the graph of the given equation.

21.  $y = 2x + 4$



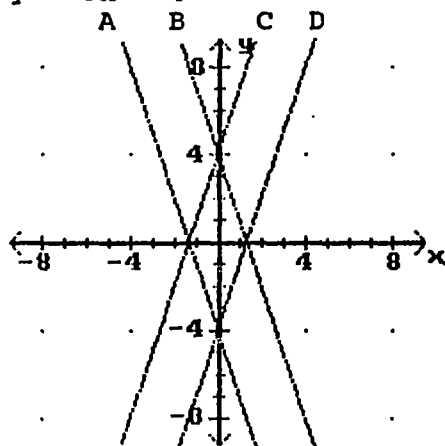
A. A

B. B

C. D

D. C

22.  $y = 3x - 4$



A. A

B. C

C. D

D. B

Give the standard form of the equation of the line satisfying the given conditions.

23. Through  $(7, -3)$ ,  
parallel to  $7x + 6y = 13$

A.  $7x + 6y = 31$

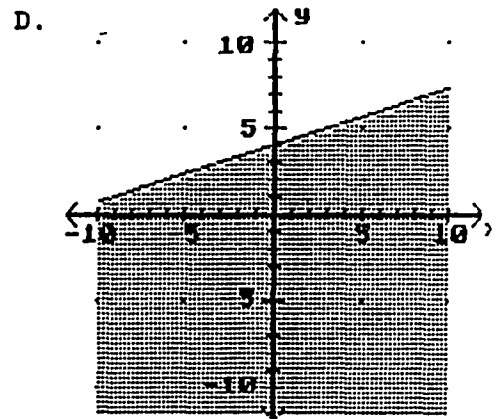
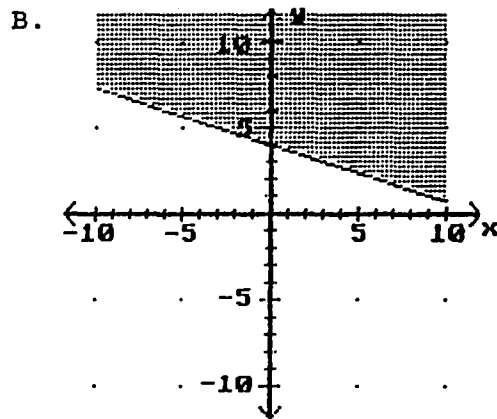
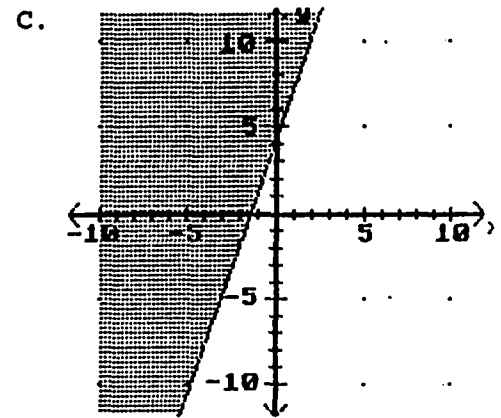
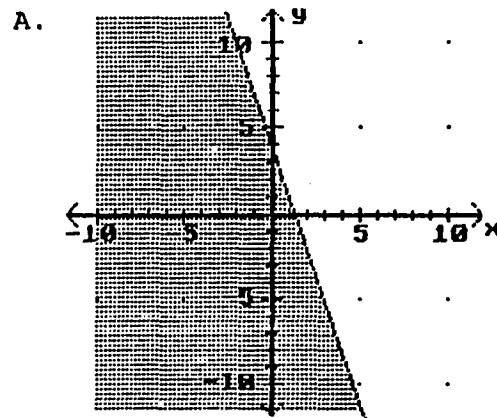
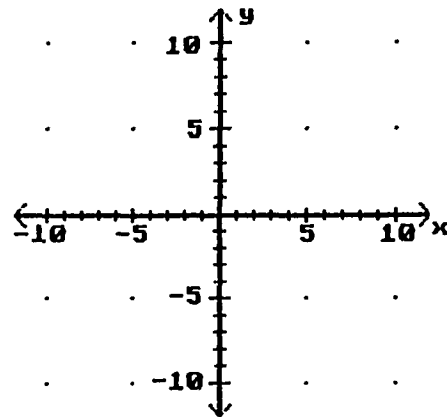
B.  $6x + 7y = -3$

C.  $7x + 6y = 13$

D.  $7x - 6y = 31$

Graph the linear inequality.

24.  $3x + y \leq 4$



Solve the system by elimination.

$$\begin{aligned} 25. \quad &5x + 9y = -21 \\ &-3x + 3y = 21 \end{aligned}$$

- A.  $\{(-6, 2)\}$     B.  $\{(-7, 2)\}$     C.  $\emptyset$     D.  $\{(-6, 1)\}$



- [ 4.2 ] 1) C
- [ 4.2 ] 2) A
- [ 4.3 ] 3) C
- [ 4.3 ] 4) D
- [ 4.4 ] 5) D
- [ 4.5 ] 6) B
- [ 4.5 ] 7) C
- [ 4.7 ] 8) B
- [ 5.2 ] 9) B
- [ 5.2 ] 10) C
- [ 5.3 ] 11) D
- [ 5.3 ] 12) D
- [ 5.4 ] 13) B
- [ 5.5 ] 14) D
- [ 5.5 ] 15) C
- [ 5.6 ] 16) B
- [ 6.2 ] 17) A
- [ 7.1 ] 18) B
- [ 7.2 ] 19) A
- [ 7.3 ] 20) A
- [ 7.3 ] 21) D
- [ 7.3 ] 22) C
- [ 7.3 ] 23) A
- [ 7.4 ] 24) A
- [ 8.1 ] 25) D

0820 - Please check yes or no to the following questions.

1. Would you take another math class taught via interactive television?

Yes \_\_\_\_\_ No \_\_\_\_\_

2. Would you take any other class taught via interactive television?

Yes \_\_\_\_\_ No \_\_\_\_\_

## VITA

Sherri Lynn Hodge-Hardin  
102 Mayfield Road  
Elizabethton, Tennessee 37643

- EDUCATION:** East Tennessee State University, Ed.D.,  
December 1995 (Emphasis: Educational  
Administration - Post Secondary and  
Private)
- East Tennessee State University, M.Ed.,  
August 1989 (Emphasis: Math Education)
- East Tennessee State University, B.S.,  
December 1987 (Major: Mathematics)
- EXPERIENCE:** Assistant Professor, Developmental Studies  
East Tennessee State University  
(August 1989 - Present)
- Graduate Assistant, Developmental Studies  
East Tennessee State University  
(August 1988 - May 1989)
- Interim Teacher, Kingsport City School System  
(February 1988 - May 1988)
- HONORS:** South Central Bell Distance Education Award,  
February, 1995
- Graduated number 1 in undergraduate class,  
ETSU's Fall Commencement, 1987
- Roselle Award for highest gpa in Math  
Department at ETSU, 1986